THE WORLD FOOD SITUATION AND PROSPECTS TO 1985

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ABSTRACT

Patterns of world food production, consumption, prices, and trade in the two decades prior to 1972 are analyzed in terms of their effect on the turbulent world food situation of 1972-74. Also examined are several issues that will shape developments in the next decade, including grain reserve levels, nutritional requirements, food aid, resource availability for producing food, weather, and demand for food. Projections to 1985 of world food supply and demand are included, and differences among developing countries are outlined.

The analysis concludes that factors giving rise to the present world food situation are largely transitory and can be corrected. Food supplies will remain tight and their prices high for the next year or two, but in the longer term and for the world as a whole, more food can be produced per person and food production can be generally adequate to meet demand. But, substantial malnutrition will probably persist among low-income groups in the less prosperous developing countries, and special national and international programs will be necessary to help those most seriously threatened.

Key Words: *Agriculture, Climate, Consumption, Demand, Developing Countries, Exports, Fertilizer, Food, Grain, Green Revolution, Irrigation, Land, Livestock, Prices, Projections, Rice, Supply, Trade, Weather, Wheat.*

FOREWORD

This study was conceived in September 1973, shortly after Secretary of State Kissinger proposed to the United Nations that it sponsor a World Food Conference. It was evident that the U.S. Government would need a compilation of basic information and analysis about the world food situation. It was also evident that there was great need for a published document to better inform the public, which was clearly concerned about the situation, but which was being subjected to a barrage of confusing views, mostly apocalyptic. Fulfillment of these needs was the ambitious objective of the study.

The study is designed to provide a comprehensive analysis of the factors which influenced food production, consumption, and trade in the two decades prior to 1972, the causes for the turbulent developments of 1972–74, and the main factors which will shape developments in the next decade.

The report is not aimed at an evaluation of the various arguments surrounding critical short-run needs for help, nor at a detailed exposition of the immediate world food situation.[1] The two decades prior to 1972 are examined because they were periods of rapid changes in world agriculture, which revealed some important weaknesses, but also something of the great potential for increased food production in the poorer countries as well as in the developed countries. The study considers the next 10 to 15 years, when it will be possible to realize a significant part of the potential if appropriate choices are made soon. Population policies are not discussed because the range of possible variations in population growth to 1985 is so small that the growth of demand for food would be little affected.[2] In a longer time span, alternative population growth rates become quite important.

Chapters 1, 2, and 3 comprise a review of the main past developments and the present situation. Chapter 4 contains projections of world food supply and demand to 1985. Chapter 5 discusses a key issue, grain stocks. Chapters 6 through 10 are supportive: they outline the issues surrounding nutritional levels and food aid; examine important factors influencing food supply and demand; and point out the differences among the less affluent countries of the world. These chapters are preceded by brief summaries for the convenience of the reader.

Chapter 11 reports briefly on the World Food Conference, which was held in Rome during November 5–16. It is too early to judge whether or not the implementation of the resolutions of the conference is likely to significantly affect the future world food situation.

This study was a team effort. It is impractical to name all who made significant contributions, so I list only those who were primarily responsible.

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[1] For more details on recent developments and the present situation, see: *World Agricultural Situation*, Sept. 1974 and Dec. 1974, the *World-Fertilizer Situation: 1975, 1976, and 1980*, supplement to the *World Agricultural Situation*. Sept. 1974, and the *World Monetary Conditions*, Dec. 1974. Economic Research Service, USDA.

[2] United Nations, *Assessment of the World Food Situation, Present and Future*, Rome, 1974, p. 82.

The study was conceived in its broad outlines by myself and William Gasser. Harry Walters, on leave from the International Bank for Reconstruction and Development, directed the main construction of the study and prepared the original manuscript. He was directly assisted in this by L. Jay Atkinson, Linda Bernstein, Charles Hanrahan, and Harry Trainor. William Gasser, Richard Kennedy, Harry Walters, and I worked on the preparation of the final manuscript, and Angela Wray devoted extraordinary zeal to editing and shaping it.

Many parts of the study were based on the contributions of individual members of this Division and other parts of the Department of Agriculture: Tony Rojko—projections; Pat O'Brien—grains; Dana Dalrymple—the Green Revolution; Richard Reidinger—fertilizer; Scott Steele—grain stocks; Richard McArdle and Rod Steele—the impact of weather on grain yields; Arthur Mackie—trade and information availability; Hal Goolsby—international monetary and balance of payments issues; Joseph Barse—policy issues and feeding grains to livestock; Riley Kirby and Charles Gibbons—statistics; Robert Tontz—food aid; Richard Kennedy and Sharon Webster—the World Food Conference; Orville Aarons—calculations and initial graphics. Frances Truhan typed the original manuscript and Kathy Blythe, Janice Danchik, Patricia Goodger, and Carol Zrioka typed subsequent drafts.

The study benefited from the valuable advice and criticisms of many inside and outside the Department of Agriculture. We could not incorporate all the good advice we received nor did our efforts entirely match our ambitious objectives, but limitations of time, resources, and our own abilities are the only explanation for this.

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CONTENTS

SUMMARY AND CONCLUSIONS

This is a period of great international anxiety about the world's ability to feed its growing population. In 1972, the world food situation was transformed from one of food surpluses and low prices to one of relative food scarcity and high prices. This rapid reversal has raised again a wave of widespread food-population pessimism similar to that which has swept over the world several times since Thomas Malthus wrote his influential essay in 1789.

Alternative Judgments

A wide spectrum of opinion exists about the causes of this rapid change in the world food situation and its likely development in the future. One judgment is that:

> "We have reached, or nearly reached, the limit of the world's ability to feed even our present numbers adequately." In this view, ". . . the demand for food increases without limit," so that, ". . . the chances of increasing the world's per capita supply of food are poor." Thus, "our government must, during the years immediately ahead, face the agonizing decision: which country will receive our food aid and which will not; realizing that regardless of the decisions a goodly number of human beings will die." [1]

A second judgment is that the events of the early 1970's signal a fundamental shift in the structure of the world food economy. In this view, we have entered

> ". . . a period of more or less chronic scarcity and higher (food) prices." The reason is that ". . . the soaring demand for food, spurred by both continuing population growth and rising affluence, has begun to outrun the productive capacity of the world's farmers and fishermen." [2]

In this view, limits to expanded food production require reduced consumption by the world's rich to feed the world's poor.

A third judgment is that while the situation for the next year or two is precarious, it has resulted from a combination of factors which can be overcome. In this view,

> "for the next decade or so the probability is good that (world) food production, in total, will keep a half step ahead of population growth, but that there will be times and places of critical shortage." [3]

This last view, which is similar to that of a study by the United Nations,[4] is essentially the conclusion of this study:

> The factors which have given rise to the present world food situation are largely transitory and can be corrected by intelligent policies. Very high prices and limited supplies of food and fertilizer are likely to prevail for the next year or two. The developing countries that rely on imported grain and fertilizer will be the most adversely affected. Any serious deterioration in their food production or in general world crop conditions in 1975 or 1976 could have serious consequences requiring additional emergency measures.
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> In the longer term, food prices relative to prices of other goods and services can be expected to fall from current high levels, but may remain somewhat higher than in the late 1960's. Also, many aspects of food production and consumption that prevailed during the two decades prior to 1972 will reappear. During that period, more food was produced per person, food supplies were generally adequate to meet demand, and the life expectancy of the world's population increased significantly. This will continue in

[1] Declaration on Population and Food, The Environmental Fund, *The Washington Post*, Oct. 25, 1974.

[2] Brown, Lester R., with Erik P. Eckholm, *By Bread Alone*, published for the Overseas Development Council, Praeger, 1974.

[3] Paarlberg, Don, *Food and People*, published statement for the 43rd Annual Convention of the Northeastern Poultry Producers Council, Philadelphia, Oct. 22, 1974.

[4] United Nations World Food Conference, *The World Food Problem—Proposals for National and International Actions*, published for the World Food Conference, Rome, 1974. This study (p. 5) says "It (the World Food Conference) should combine a sense of immediate urgency with a long-run optimism that the developing countries, with assistance from developed countries, can achieve the necessary increases in food output while meeting more adequately the goals of rural development and social justice."

most countries and for the world as a whole. But, also as in the past, substantial malnutrition will probably persist among low-income groups in the less prosperous developing countries, and special national and international nutritional programs will be necessary to help those most seriously threatened by food shortages.

The recent adjustments in relative prices of food, petroleum, and other commodities were exceptionally large and had exceptional causes. But the size and abruptness of the recent price increases should not obscure the fact that some adjustments were necessary to reorient priorities with respect to resource use. Between 1967 and 1974, the world needed more food than was being produced and was able to supply part of the needs by drawing down stocks. Higher food prices are now stimulating more food production. Higher fertilizer prices are stimulating expansion of the fertilizer industry. Higher grain prices are reducing grain used for livestock feed. Higher petroleum costs are causing a search for other energy sources and causing a different attitude toward energy use.

The view that the world food situation can be improved recognizes that major problems must be solved, and that many of them are not self-correcting. Among the most pressing are transferring food from the developed food-exporting countries to the food-deficit developing countries (without preventing needed increases in food production in these countries), providing for emergency disaster and famine relief, achieving an acceptable degree of stability of world food prices, and finding the proper combination of techniques and policies to bring about a substantial improvement in food production and distribution in developing countries.

Many views of the world food situation focus on immutable forces or circumstances (such as the limited surface of the earth, changed climatic patterns, or the fixed nature of consumption patterns) which are thought to be beyond the control of people. The analysis in this study indicates, however, that much of what has happened in the development of the world food situation can be traced to government policies and basic human conditions (such as income distribution and poverty), and suggests that governmental and individual choices will continue to be critical in the future. The world food situation can be changed to the extent that governments and individuals see needs for change and are willing to modify those policies and conditions that influence food production and consumption.

While this study does not support the judgments that world food supplies per capita are likely to decline or that the growth of the world food supply is likely to lag behind growth in demand, these possibilities cannot be ruled out. There are uncertainties clouding all views of the world food situation. For the future period considered in this report, from the present through 1985, one cannot be sure that the weather will be favorable for agriculture, nor can one be sure that existing food production technology will be used properly, or that new technological developments will become available when needed. Nor can one be sure that governmental policies will be appropriate to the problems.

In view of the uncertain nature of world food supplies, it would seem to be wise social policy to ensure against major shortages, and to be prepared to pay reasonable cost to maintain moderate stocks or reserve capacity or to absorb some surpluses if they should result.

Relatively small changes in supply can create great changes in food prices. Experience demonstrates that it is impossible for the world, or any country, to produce each year exactly the right amount of food; that is, those amounts which would result in stable prices that are both economically justifiable and politically acceptable. The problems of surplus farm production—products which cannot be sold at acceptable prices—are familiar, having been widespread during the last two decades. The problems of general shortages have come to the fore in the last 2 years, and they are more frightening.

Food stocks can provide insurance against short-run shortfalls in production. An important insurance against long-run shortfalls is a backlog of resources and basic and applied agricultural research, supported by policies and institutions through which research and resources can be quickly moved into the fields to increase production. Agricultural research needs to be directed especially toward the problems of increasing productivity in the developing countries where modern scientific agriculture is only beginning to be adopted.

Causes of the Present Situation

The phenomenon of high food prices and uncertain food supplies arose out of a combination of circumstances, policy changes, and long-term development trends, which raise very important issues but which do not indicate a long-run shortage of food.

During the late 1960's and early 1970's, the developed grain-exporting countries were restricting grain production in an effort to reduce surplus stocks. Prices of grain and many food and farm products were at low levels. Overcapacity in the fertilizer industry caused low prices of fertilizer during these years. The world seemed to have plentiful, inexpensive supplies of food and of the inputs to produce food during 1968-71.

But in 1972, world food production declined for the first time in two decades. The USSR imported an exceptionally large amount of grain in 1972/73, and in 1973/74 the developing countries increased their grain imports. These purchases quickly depleted the

reduced stocks of the major exporting countries, especially those of the United States, which had held the largest quantity. Because the United States had been the major supplier of food aid, its grain shortages resulted in reduced food aid shipments to developing countries.

Grain and other food prices rose to exceptionally high levels, but with very uneven effects in different parts of the world. Prices for producers and consumers changed very little in Europe (especially in the European Community) and in the planned economies, but rose sharply in the grain-exporting countries and in many food-importing developing countries.

World food production rose substantially in 1973, but not enough to rebuild stocks. Production in 1974 was below expectations, especially in the United States, and stocks still remain low and prices high. With the elimination of grain stocks, the world is now dependent on annual food production to offset annual increases in demand.

These agricultural problems were compounded by several other developments. Rapid economic growth around the world in 1971-73 generated greater demands for food. Elimination of overcapacity in the fertilizer industry and increased demand has resulted in tight supplies and high fertilizer prices since 1973. These conditions, along with high energy and petroleum prices, rapid inflation, and major monetary adjustments, have all contributed to high food prices.

Fundamental Problems

Two major world food problems which had been developing during the 1960's have been brought into sharp focus: the increasing grain imports of the developing countries, and the sporadic but increasingly large grain purchases of the planned economies.

The developing countries in particular have become progressively more dependent on the developed countries for food and fertilizer. This dependency is partly an outgrowth of the large grain imports they were able to make in the late 1960's and early 1970's, when the surplus stocks in several developed countries permitted exports at relatively low commercial prices and on concessional terms.

But partly because of the understandable efforts to reduce food surpluses in developed countries, partly because of production adversities, and partly because of a complex of international political-economic developments (including the energy crisis), prices of food and fertilizer are now unprecedentedly high, and the quantities of food aid shipments are greatly reduced. In addition, many of the developing as well as the developed countries are dependent on petroleum imports, which are also high priced. The developing countries thus face an abrupt increase in import costs for food, fertilizer, and petroleum which are beyond the means of many of them.

Among the major impediments to increasing food production in both the developing and the planned economies are policies designed to maintain low and stable food prices to consumers. These policies have dampened the farmers' incentives to produce food in some of the countries and have partly made necessary their large grain imports.

Policies designed to support farm income contributed to the past surpluses of developed countries. These policies sometimes also had the effect of keeping food prices to consumers higher than they might otherwise have been, and of creating a substantial budgetary burden to be borne by the taxpayers. Changes in such policies in the United States helped to reduce stocks, but also contributed to low prices of grains to both importers and livestock feeders during 1967-71, thus reducing the incentives for grain production in some countries and strongly stimulating livestock production and consumption in others. The reluctance of the developed countries to resume the agricultural policies which helped generate large surpluses in the past becomes understandable in view of these experiences.

Food scarcity and high prices have focused attention on the problem of malnutrition—a problem which persisted throughout the past two decades but was made especially serious by recent developments. Many of the world's poorest consumers depend largely on grain and most of their income is spent on food. They are the most adversely affected by high grain prices and dwindling food aid shipments. The United Nations has estimated that about 460 million of the world's 3.8 billion people are malnourished.[5] Measures to offset hunger have been proposed, including expanded programs to feed groups especially threatened by malnutrition.

Near and Longer Term Problems

The availability of inputs—the underlying major determinant of the world's ability to produce more food—does not appear to be an impediment to future increases in production. Perhaps twice as much land is available for food production as is presently being used. While bringing this land into production would involve some costs, these costs are not prohibitive.[6] The technology and inputs (such as fertilizer) to greatly expand production either exist or can be developed in both the developed and developing countries. Substantial increases in production capacities are now underway in both developed and developing countries. Trends of the past two decades do not indicate a significant slowing down of yield increases.

[5] United Nations, *Assessment of the World Food Situation, Present and Future*, Rome, 1974.

[6] It is sometimes said that these costs would be excessive but FAO has estimated that to add 5 million to 7 million hectares to food production would cost between $137 and $312 per hectare. U.N., *The World Food Problem—Proposals for National and International Actions*, op. cit. pp. 64-67.

The basic imbalances in world food production and consumption which produced surpluses in developed countries, growing imports in developing countries, and malnutrition among some groups, remain uncorrected, however. Correction of these imbalances will require serious reevaluation of agricultural, food, and trade policies in many parts of the world. Far greater attention will need to be given to stimulating food production in some developing and planned economy countries, to encouraging a more viable basis for world agricultural trade, and to establishing a broader based system of world food security. However, the simplistic goal of food self-sufficiency is not defensible. While there is clearly a need to produce much more food in many developing countries, the stimulation of food production without adequate attention to costs would reduce the general development of these countries and would conflict with the building of a more viable agricultural trade system, which is necessary if the world is to be fed adequately, efficiently, and at the lowest cost.

Crucial Issues

1. *Will the real cost of food (the cost of food relative to other goods) be higher in the future than in the past?* It probably will be higher because certain food prices, particularly grain prices, were especially depressed during the years immediately preceding 1972, and because important food production inputs such as fertilizer will be more expensive. Nominal food prices will also be higher because of inflation. But when food production is increased to overcome recent shortages, food costs can be expected to fall to a level considerably below present prices (ch. 2, 3, and 9).

2. *Has the world sufficient resources to continue to increase food production?* There is sufficient land and raw materials for productive inputs to greatly increase food output. How fast production will increase, and whether this increase in food production will take place mainly in the developed or the developing countries will depend more on policy decisions than on natural forces or raw material inputs (ch. 4, 8, and 10).

While the analysis of this study indicates that the availability of resources permits an adequate growth in food production for the world as a whole, it also notes that where such production takes place is crucial. The trend over the past two decades has been one of surplus production in the developed countries and increasing deficits in the developing countries. Most projections of the future indicate a continuation of these trends. However, one of the alternative projections in this study indicates that the food deficits of developing countries could be reduced sharply by 1985 if they were able to increase their use of fertilizers and associated techniques at a faster rate than they have in the past.

3. *Will food supplies and prices continue to be unstable?* This will depend partly on policies adopted with respect to food stocks. Instability in the world's weather will produce instability in the supply of food unless reserve measures are adopted. Because of the inelastic demand for food, the absence of stocks will result in major fluctuations in prices whenever the growth in supply departs much from the growth in demand.

Food stocks are needed and they will benefit the entire world, but how large they should be, who should hold them, who should pay for them, and how they should be managed are complex subjects. The need for a minimum level of stocks is obvious. The need for larger stocks should be carefully considered. While their advantages are obvious, their disadvantages are less obvious but also significant. The management of such large stocks would have a major impact on food production and prices (ch. 2, 3, and 5).

4. *Does "rising affluence" impose a restricted diet on the world's poor? Should consumption of livestock products be reduced to permit more basic food grains for poor people?* Food consumption patterns around the world are determined by income distribution and by the type and quantity of basic foodstuffs produced in each locality. In the short run, if grain supplies are limited as they are now, high consumption by the affluent raises prices and thus restricts the diets of the poor. In the longer run, the price of food depends on many factors, including governments' policies, which are a more important influence than the level of consumption of the affluent.

When some eat so well and others are malnourished, there is much appeal to the argument that meat consumption should be reduced to free grain for hungry people.[7] This is, however, neither an efficient nor an effective way to accomplish the objective of feeding the world's truly hungry. The majority of the world's hungry need rice or wheat. These are a small fraction of the grain consumed by ruminant livestock. Also, grain is only a fraction of the total feed consumed by ruminant livestock. They eat mostly roughages which would not be available as human food unless converted to livestock products.

If some food grains were conserved by feeding less to livestock, however, their purchase, shipment, and distribution would have to be financed and managed through a deliberate food-aid mechanism if they were to reach those who were actually malnourished. If this was not done, the effect of foregone meat consumption would be simply to reduce grain prices temporarily to all consumers. The benefit to the malnourished would be marginal and temporary. More direct and efficient methods are available to accomplish a transfer from the rich to the poor of food or income to buy food (ch. 6).

5. *Are there developments in the world's climate*

[7] Mayer, Jean, "If Americans would decrease the meat they eat by 10 percent, it would release enough grain to feed 60 million people," *Newsweek*, Nov. 11, 1974.

which will limit increases in food production? There is insufficient evidence to support such a conclusion, but world weather is unstable and unpredictable and the world needs to be better prepared for adversities than it has been since 1972. In the short run, such preparedness requires food stocks. In the medium term, excess resources could also help, but in the long run, it requires a backlog of technology to deal with protracted adversities (ch. 8).

6. *Should agricultural policies around the world be adjusted?* The growing imports of food grains by developing countries, the sporadic but progressively larger imports of grains by the planned economies, the potential for surplus production in developed countries, and the declining share of developing countries in world agricultural trade all point to the need for serious reconsideration of agricultural policies in many countries (chs. 2 and 3).

1. RECENT DEVELOPMENTS AND SHORT-TERM OUTLOOK

Developments since 1972 have again caused widespread anxiety about the world's ability to produce and distribute enough food at reasonable prices to meet the increasing demands of growing populations and rising incomes. Prior to 1972, the world had experienced two decades of expanding food production and plentiful, even surplus, supplies of grain and some other foods along with rapid increases in general agricultural productivity in many areas. Prices of grain and food declined and large amounts of grain and other foods were available to aid developing countries. Grain reserves provided a cushion against shortfalls in production, but they were considered an undesirable burden by the countries holding them.

Now, the immediate and long-term future of the world food situation seems more uncertain than at any time in the past two decades. Food prices are high and food reserves, primarily grain stocks, are low. The quantities of food aid have declined. Land previously held out of production in some major exporting countries has been put back into crops, but 1974 did not result in the large production increases anticipated. High food prices and food shortages have appeared in many countries and famine has occurred in some areas. Supplies of fertilizer and other agricultural inputs are tight and their prices high. These conditions, in the face of expanding demand for food, have placed the world in a precarious position where the availability of food is uncertain, its price high, and both are directly dependent on current production levels.

This extraordinary situation has developed because of a series of interrelated short-term developments considered in this chapter, and because of the convergence of certain long-term trends analyzed in subsequent chapters.

The 1972 Decline in World Food Production and Its Consequences

World food production declined modestly in 1972—only 1.6 percent at the world level—but the impact of this decline on some countries, commodities, trade patterns, prices, and per capita food production levels was serious. The crop shortfalls were particularly unsettling because they broke the growing confidence about overcoming the world food problem that had emerged in the period after 1966.[1] The "Green Revolution"—the use of new high-yielding varieties of wheat and rice with fertilizer, other chemicals, and irrigation—appeared by 1967-68 to be transforming production possibilities in the densely populated developing countries of South and Southeast Asia. Between 1961-65 and 1971, total world food production grew 26 percent (table 1).

During these years, food production increased slightly more rapidly in developing countries (3.1 percent annually) than in developed countries (2.7 percent). Slower growth in developed countries was partly due to the accumulation of agricultural surpluses—despite large-scale aid shipments to developing countries—which caused some of the developed countries to take steps to restrict production. Prices of grains and most other food and agricultural products were stable or declining between the mid-1950's and mid-1960's, and they were especially low during 1967-71 (ch. 3). Low prices and plentiful supplies of fertilizer during 1967-71, due to excess capacity in the fertilizer industry, contributed to the rapid advance of the Green Revolution in developing countries and to productivity gains in developed countries.

While the growth rate of food production was slightly higher in developing countries from 1961-65 to 1971, per capita progress was lower because their annual population growth was 2.5 percent, compared with 1 percent in developed countries. Per capita food production in the developed countries in 1971 was 15 percent above the 1961-65 average and it dropped only slightly as a result of 1972's shortfall. But the developing countries were producing only 5 percent more food per capita in 1971, and the 1972 shortfall pushed them back to the per capita level they had reached a decade earlier. Despite the very substantial recovery in 1973—7 percent in developed and 3 percent in developing countries—the developing countries were still below their 1970 per capita level and greatly behind the per capita production gains of the developed countries.

Although the drop in world food production in 1972 was modest, it was felt virtually everywhere. Sharp declines took place in many developing coun-

[1] During 1963-66, India experienced two successive droughts and the USSR had two crop failures.

Table 1—Indices of world population and food production[1]

Calendar year	World			Developed countries			Developing countries		
	Population	Food production		Population	Food production		Population	Food production	
		Total	Per capita		Total	Per capita		Total	Per-capita
	1961-65=100								
1954	84.2	77	91	89.1	77	86	80.6	77	96
1955	85.7	80	93	90.3	81	90	82.5	78	95
1956	87.3	84	96	91.5	85	93	84.4	82	97
1957	89.0	85	96	92.7	86	93	86.3	83	96
1958	90.7	90	99	93.9	91	97	88.4	87	98
1959	92.4	91	98	95.1	92	97	90.5	89	98
1960	94.2	94	100	96.3	96	100	92.8	92	99
1961	96.1	95	99	97.5	95	97	95.1	94	99
1962	98.0	98	100	98.9	98	99	97.5	97	100
1963	100.0	100	100	100.1	99	99	99.9	100	100
1964	101.9	103	101	101.2	103	102	102.4	104	102
1965	103.9	104	100	102.3	104	102	105.0	104	99
1966	105.9	109	103	103.4	111	107	107.7	106	98
1967	107.9	114	106	104.3	115	110	110.4	111	101
1968	109.9	118	107	105.3	119	113	113.2	115	102
1969	112.0	118	105	106.3	117	110	116.1	121	104
1970	114.2	121	106	107.3	119	111	119.0	126	106
1971	116.4	126	108	108.3	125	115	122.1	128	105
1972	118.7	124	104	109.3	124	113	125.3	125	100
1973	120.9	133	110	110.2	133	121	128.5	132	103

[1] World excluding communist Asia.

Source: Economic Research Service.

tries, especially in South Asia. In parts of Africa where production was already precariously low due to a prolonged drought, production suffered further setbacks. But production also declined in Canada and Australia —major grain exporters—and in the USSR. The USSR, customarily a net grain exporter, became the world's largest importer of grain, importing a total of 30 million tons (net) in 1972 and 1973, compared with total *net exports* of 8.6 million tons in the previous 2 years.[2]

Changes in Grain Production, Consumption, Trade, and Stocks

Grain is the most important single component of the world's food supply, and changes in grain supply and demand conditions are the best indicators of developments in the world food situation. Grain accounts for between 30 and 70 percent of the value of food production in all world regions. It is the major, sometimes almost exclusive, source of food for many of the world's poorest people, supplying 60 to 75 percent of the total calories many of them consume. However, in many developed countries, more grain is fed to livestock than is consumed directly as grain products (ch. 6).

Production

Between 1961 and 1973, world grain production (including milled rice) increased from 833 million to 1,264 million tons, an average increase of 36 million tons per year. While the world requires 25 million additional tons of grain per year to maintain the present level of per capita use (330 kg), annual consump-

[2] Net USSR grain trade in 1970-73 was: +3.5, +5.1, −10.9, and −19.1 million tons.

tion has increased as much as 40 million tons or more in some of the past 5 years (ch. 2).[3]

World grain production declined slightly in 1963 (5 million tons) and in 1965 (1 million tons), but in 1972 it fell 35 million tons, equal to 1 year's average annual growth. The 89-million-ton increase in 1973 was sufficient to compensate for 1972's shortfall, but grain prices remained high and carryover stocks low. Contrary to expectations, 1974 proved to be a poor year, especially for grains in the United States, with the result that the food situation has deteriorated even further.

Consumption, Trade, and Stocks

Heavy pressure has been placed on world food supplies since 1972, not only because of the decline in grain production that year, but also because of growth in grain consumption, an accompanying increase and shift in world grain imports, and a consequent decline in grain stocks.

Statistics on the annual uses of grains—for direct human consumption, animal feed, seed, and industrial uses—and losses do not exist for many countries.[4] Coarse (feed) grains are largely produced, consumed, and traded in and among the developed countries and are primarily fed to livestock. The developed countries have been producing wheat in amounts far greater than their domestic needs and exporting to the deficit developing countries and, sporadically, to the centrally planned economies. Estimates of annual world grain consumption (domestic disappearance) of the six major grains (excluding rice and minor grains) indicate a substantial increase in annual grain consumption in the last 5 years. Between 1969 and 1974, consumption exceeded production in all years except 1971 and 1973, partly because of the decisions of countries holding grain surpluses to reduce their stocks. The excess of consumption over production during the period totaled 53 million tons (table 2 and ch. 2).

The 1972 drop in grain production was accompanied by a sharp rise in world grain exports—from 111 million tons in 1971/72 to 142 million tons in 1972/73 and 151 million tons in 1973/74. As a result, world grain stocks declined precipitously.

The upsurge in world grain imports in 1972/73 started with massive purchases by the centrally planned economies, especially the USSR. While Europe and Japan are major grain importers, their imports follow a fairly consistent trend and they were not a significant factor in the recent upsurge in world food grain imports. With the Soviet Union's impact on the increase in imports dissipating, the People's Republic of China (PRC) and the developing countries became the major countries accounting for the higher grain imports in 1973/74 (table 3).

The high prices and uncertainties about world food supplies, created by the various events since 1972, are not, therefore, simply the result of crop shortfalls. Although they were triggered by these shortfalls, the impact of the production shortfalls was magnified by the critical position of grain stocks relative to world import demand.

While the events of 1972-74 were worldwide in scope and impact, the United States and the USSR were uniquely involved. Of the 31.5-million-ton increase in world grain exports in 1972/73, the United States accounted for over 30 million tons, and the USSR's increase in net imports was almost 20 million tons. The United States had almost as large a share of the higher 1973/74 world grain exports. The United States also absorbed most of the decline in world grain stocks. Whereas world end-of-year wheat stocks fell from 74 to 56 million tons between 1971/72 and 1973/74, U.S. stocks fell from 23.5 to 6.8 million tons. World feed grain stocks fell from 77 to 52 million tons. U.S. feed grain stocks dropped 26 million tons. The much lower 1974 U.S. grain crop sharply reduced exportable supplies.

Price Movements

The 1972 shortfall in world food production, the upsurge in food imports, and the drawdown in stocks, along with inflation, rapid economic growth, and monetary adjustments, produced a dramatic increase in the prices of virtually all agricultural commodities (table 4). The most severe impact was on the major food grains—wheat and rice. Wheat prices increased from $60 per ton in the second quarter of 1972 to $210 per ton in the first quarter of 1974, a 250-percent increase. During the same period, the price of rice rose over 300 percent—from $132 to $570 per ton.

Food prices began to rise sooner and more steeply than commodity prices in general and much faster and steeper than industrial commodity prices. Between October 1972 and August 1973, the wholesale index of

[3] The tonnages used here are taken from the *FAO Production Yearbook 1972* and the *FAO Monthly Bulletin of Agricultural Economics and Statistics*, Vol. 23, Feb. 1974, with rice converted from paddy to milled at 66.6 percent. The "total grain" series of the U.S. Dept. of Agriculture (USDA) includes only the major grains—wheat, rye, barley, oats, corn (maize), and sorghum. Rice is treated separately. When milled rice is added to the USDA series, that series ranges from 55 million to 100 million tons below the FAO series, which includes, in addition to rice, mixed grains, buckwheat, millet, and "other cereals." The absolute difference between the two series has widened, reflecting the increased production of minor grains, but the relative difference has not changed.

[4] The best estimates available for the preparation of this report were the food balances prepared by FAO for 1964-66. FAO has just recently completed food balances for the years 1969-71.

Table 2—World production, consumption, exports, and stocks of six major grains[1]

Year	Production	Consumption	Exports	Beginning stocks[2]
		million metric tons		
1969/70	826	839	102	191
1970/71	824	856	109	169
1971/72	911	893	111	131
1972/73	888	925	142	149
1973/74	970	960	151	108
1974/75[3]	916	931	137	108

[1]Wheat, rye, barley, oats, corn, and sorghum. [2]Selected countries; Total adjusted for estimated annual changes in the USSR. [3]Preliminary.

Source: Foreign Agricultural Service and Economic Research Service, *Grain Data Base*, Nov. 1974.

Table 3—World net grain exports and imports

Country	1969/70-1971/72 average	1971/72	1972/73	1973/74
		million metric tons		
Developed countries	31.9	41.9	62.4	58.4
United States	39.8	42.8	73.1	72.5
Canada	14.8	18.3	18.8	13.1
Australia & New Zealand	10.6	10.8	5.8	9.9
South Africa	2.5	3.7	.4	4.0
EC-9	-16.6	-14.0	-13.4	-13.0
Other West Europe	-4.8	-4.5	-5.3	-8.9
Japan	-14.4	-15.0	-17.0	-19.2
Central plan countries	-6.8	-13.0	-32.2	-15.9
East Europe	-7.6	-9.2	-8.0	-4.8
USSR	3.9	-4.3	-19.6	-4.4
PRC	-3.1	-15.4	-4.6	-6.7
Developing countries	-19.1	-26.9	-23.2	-30.3
North Africa & Middle East	-9.2	-11.9	-8.1	-14.9
South Asia	-5.7	-5.4	-4.5	-7.0
Southeast Asia	3.2	3.3	1.2	2.5
East Asia	-8.4	-9.2	-10.4	-10.2
Latin America	3.2	-2.0	–	.7
Central Africa	-1.9	-2.0	-2.0	-2.1
East Africa	-.3	.3	.6	.7
Other	-.2	-.2	-.3	-.3
World total exports	107.6	111.2	141.8	151.0

Source: Foreign Agricultural Service and Economic Research Service, *Grain Data Base*, Nov. 1974.

Table 4—Prices and price indices for selected agricultural commodities

Year		Wheat	Corn	Milled rice	Soybeans	Cotton	Barley	Sugar raw	Bananas	Tea	Coffee	Cocoa	Beef
							dollars per metric ton						
1971	I	63	65	126	117	694	51	105	141	785	1,100	623	1,363
	II	62	64	121	117	729	48	96	139	687	950	579	1,392
	III	61	55	134	124	773	42	92	146	744	940	620	1,323
	IV	60	119	136	118	820	45	105	136	682	960	540	1,305
1972	I	60	52	131	124	906	46	188	147	780	990	594	1,415
	II	60	53	132	134	805	46	153	180	738	1,040	661	1,513
	III	67	56	153	135	719	44	139	164	706	1,260	761	1,485
	IV	94	61	175	143	793	51	174	155	671	1,240	831	1,508
1973	I	102	80	194	221	968	53	201	152	766	1,340	882	1,852
	II	104	88	NA	333	1,131	59	209	169	693	1,440	1,350	1,834
	III	164	113	NA	315	1,727	85	205	177	826	1,530	1,827	2,226
	IV	187	110	NA	224	1,897	85	231	161	705	1,540	1,618	2,121
1974	I	210	127	570	240	1,837	103	425	158	843	1,570	1,670	1,921
	II	151	115	615	210	1,442	89	508	NA	NA	1,620	1,721	1,536
High point		221 (2/74)	131 (2/74)	625 (5/74)	393 (6/73)	2,061 (1/74)	108 (2/74)	522 (6/74)	207 (6/67)	934 (3/74)	1,640 (3/74)	2,500 (5/74)	2,459 (8/73)
							1963 = 100						
1971	I	97	120	88	114	107	116	56	97	88	147	111	163
	II	95	119	85	114	112	109	51	95	77	127	104	167
	III	94	102	94	120	119	95	49	100	83	125	111	158
	IV	92	91	95	114	126	102	56	93	76	128	97	156
1972	I	92	96	92	120	139	105	101	101	87	132	106	169
	II	92	98	92	130	124	105	82	123	83	139	118	181
	III	103	104	107	131	110	100	74	112	79	168	136	178
	IV	145	113	122	139	122	116	93	106	75	165	149	181
1973	I	157	148	136	214	149	120	107	104	86	179	158	222
	II	160	163	NA	323	174	134	112	116	78	192	242	220
	III	252	209	NA	306	265	193	110	121	92	204	327	267
	IV	288	204	NA	217	291	193	123	110	79	205	289	254
1974	I	323	235	399	233	282	234	227	108	94	207	299	230
	II	232	213	430	204	222	202	272	NA	NA	216	308	184

Wheat: No. 2 HWW, ordinary protein, f.o.b. Gulf, buyers price. **Corn:** No. 2, yellow, f.o.b. Gulf ports. **Milled rice:** white, 5-7 percent broken, govt. standard, f.o.b. Bangkok. **Soybeans:** U.S. No. 2 yellow, f.o.b. Gulf ports. **Cotton:** U.S. strict middling 1-1/16 in. c.i.f. Liverpool. **Barley:** No. 3 or better, Minneapolis (feed barley). **Sugar:** Raw cane sugar: 96 spot, f.o.b. and stowed, Caribbean and Brazilian ports. **Bananas:** U.S., f.o.b. port of entry, first quality from Central and South America. **Tea:** Ceylon, for export, high grown, auction price, Colombo. **Coffee:** Santos No. 4, New York spot. **Cocoa beans:** New York spot price for cocoa beans from Acara. **Beef:** U.S. imported canned meat 90 percent visible lean, frozen, U.S. port of entry. Source: Economic Research Service.

prices of farm products and processed foods and feeds in the United States had risen from 22 to more than 80 percent above the 1967 level (fig. 1). These U.S. price developments were reflected in some but not all parts of the world. In 1971, most world commodity prices were below 1970 levels, but by April 1974, the world food price index had more than doubled that level, with increases in other commodity indices rapidly catching up (table 5).

Impact on Producers

The impact of these price increases was felt at the farm level late in 1972. In the United States, Canada, and Australia, the higher prices quickly made themselves apparent in higher farm incomes. Compared with 1970, 1973 farm income in these countries was up 150 percent or more (table 6).[5] Farm income growth in West European countries and in Japan was much smaller: 27 percent in West Germany, 100 percent in the United Kingdom, and about 55 percent in France, the Netherlands, and Japan.[6]

[5] Part of the increase in U.S. farm income in 1973 was due to higher prices for 1972 crops sold in 1973.

[6] The increase in the U.K. was heavily influenced by adjustments in policy to adapt to European Community (EC) membership.

In countries where world price changes are reflected fairly directly at the farm level, the prices received by farmers in 1973 were well above the prices paid for production, as well as family living expenses. But by June 1974, when the advance in other prices had caught up, farm prices were being met by accelerating farm production costs (fig. 2).

While a large part of the population in developing countries is composed of farmers, their links to the world market are weak. The higher farm prices undoubtedly increased some incomes, but in a number of developing countries this did not happen.

Impact on Consumers

Higher farm prices were followed quickly by higher consumer prices for food. In the OECD countries, average consumer prices rose 3.7 percent annually during 1961-71, but they increased 4.7 percent in 1972, 7.7 percent in 1973, and 12.5 percent between March 1973 and March 1974[7]. Even in these developed countries, food accounts for between 30 and 55 percent of the consumer price index, except for the United States, where it accounts for only 22 percent—the lowest percentage in the world.

[7] Countries that are members of the Organization for Economic Cooperation and Development are listed in table 7.

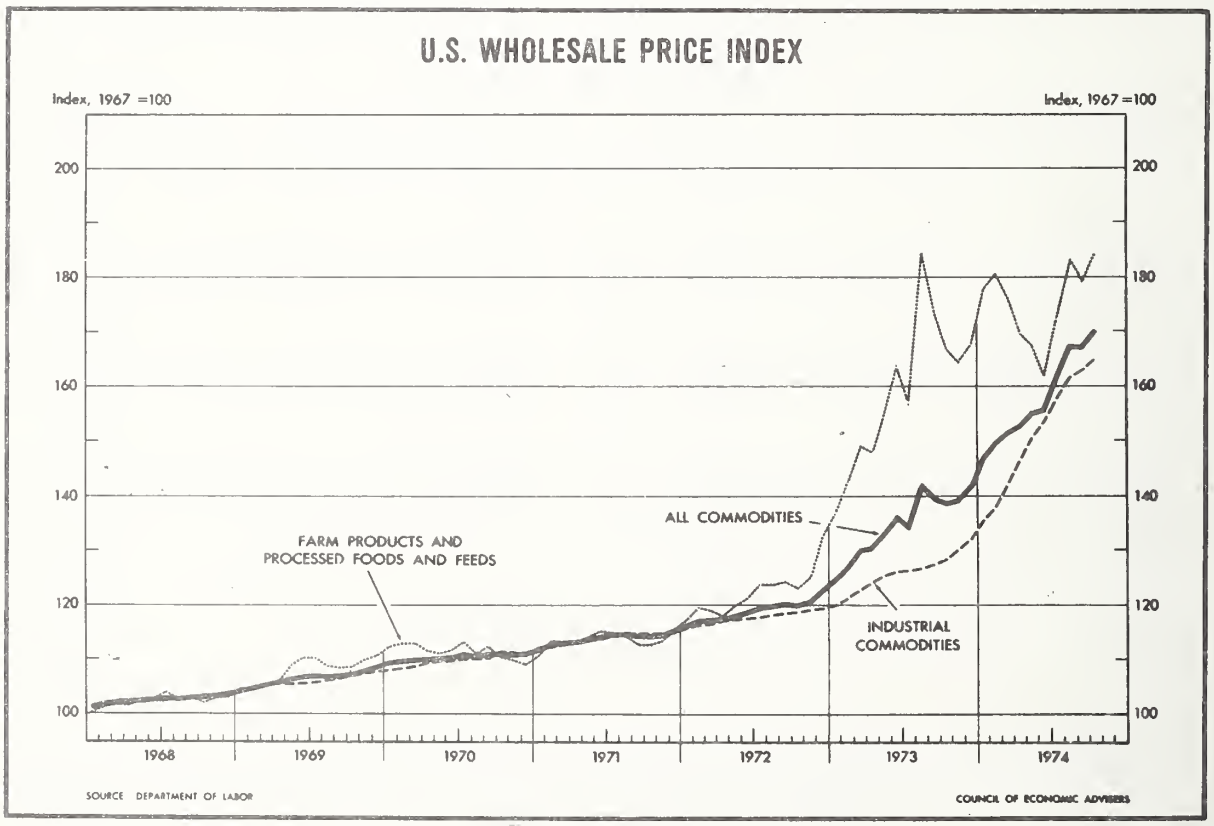


Figure 1

Table 5—World commodity spot price index

Item	1971	1972	1973	1974	
				April 15 - 30	Mid-June average
			(1970 = 100)		
All items[1]	90	109	164	218	199
Food	95	120	173	224	218
Industrial materials	85	96	153	211	176
Fibers	98	134	235	230	211
Metals	78	77	113	204	161
Oil[2]	118	132	184	613	613

[1] Weighting is based on imports into industrial countries and differs from weights of the same commodities in world production. Fuel and oil are excluded. Source: OECD, *Economic Outlook No. 15*, July 1974, p. 25.

[2] ERS estimate based on prices in *International Financial Statistics*, International Monetary Fund.

Table 6—Farm income in major grain exporting countries

Item	1970	1971	1972	1973	Ratio, 1973/70
United States					
Billion U.S. dollars	14.0	14.4	18.4	36.2	2.58
Percentage change from previous year	0.6	3.0	27.7	96.7	
Canada					
Million Canadian dollars	1,227	1,498	1,680	3,073	2.50
Percentage change from previous year	-14.5	22.0	12.2	82.9	
Australia					
Million Australian dollars	875	1,066	1,553	2,481	2.83
Percentage change from previous year	-7.0	21.8	45.7	59.8	

Source: United States: *Farm Income Situation*, U.S. Dept. of Agr. Canada: *Canadian Statistical Review*. Australia: *Quarterly National Accounts*.

In developing countries, the relative significance of food in consumer expenditures is much higher. For those countries where consumer food prices are not controlled, the impact of the high food costs has been severe, especially for the poorest segment of the population.

While retail food prices rose sharply in 1973, and accelerated in many countries in early 1974, the impact of these price increases on the cost of living (consumer price index) was even more marked because food constitutes a high proportion of the value of the items included in the cost of living (table 7). Whereas food prices increased between 6 and 16 percent in OECD countries in 1973, the impact on the consumer price index ranged from 25 to 69 percent. The moderated rise in food prices in most EC countries corresponds to the slow rise in farm prices in these countries. Both are a reflection of EC policies designed to insulate internal farm and food prices from external events.

The centrally planned economies experienced none of these effects since to a large extent their farm and consumer prices are not affected by changes in world prices, although their imports were instrumental in pushing grain prices to their present high levels (ch. 3).

The major impact of higher farm prices was therefore on the major food exporting countries—the United States, Canada, and Australia. These countries also experienced the largest increase in consumer food

prices, along with some of the non-EC countries of Europe and developing countries dependent on food imports.

The Inelastic Demand for Food

The large increase in food prices following a relatively small change in world food and grain production is in part a reflection of the inelastic demand for food with respect to price, especially grains.[8] The demand for food increases rather uniformly with population and income growth. If the supply of food keeps pace with demand, prices tend to remain fairly uniform. But if supply falls a little short of increasing demand, prices tend to rise very rapidly. If supply increases faster than demand, the price of food decreases more rapidly than the supply has increased.

[8] The price elasticity of demand is a measure of the percentage increase/decrease in the quantity purchased of a commodity resulting from a 1-percent decrease/increase in the price of the commodity. Demand for a commodity is inelastic when, either a 1-percent increase in its price results in a less-than-1-percent decrease in the quantity purchased, or a 1-percent decrease in its price results in a less-than-1-percent increase in its purchase.

But food supply tends to fall short of or exceed demand because of the unstable effect of weather on production. Food prices therefore tend to rise or decline more than proportionately to these imbalances unless the supply is modified by stock adjustments.

The large degree of stability of farm and food prices achieved in the two decades prior to 1972 resulted from government policies in grain exporting countries and in Europe and Japan designed to stabilize farm, and therefore food, prices. Surplus farm production was absorbed in the form of government-held or supported stocks and released from these stocks in times of shortage. Countries that did not follow such programs domestically could maintain stability by importing the needed amounts of grain. The United States, and other countries to a lesser degree, also provided large amounts of surplus foods, especially grain, to developing countries in the form of food aid (ch. 7). This permitted the developing countries to augment their domestic supplies and to rely on the major grain exporters to provide food in times of serious shortfalls. The elimination of these stocks in 1972 and 1973 was therefore a major factor contributing to high prices.

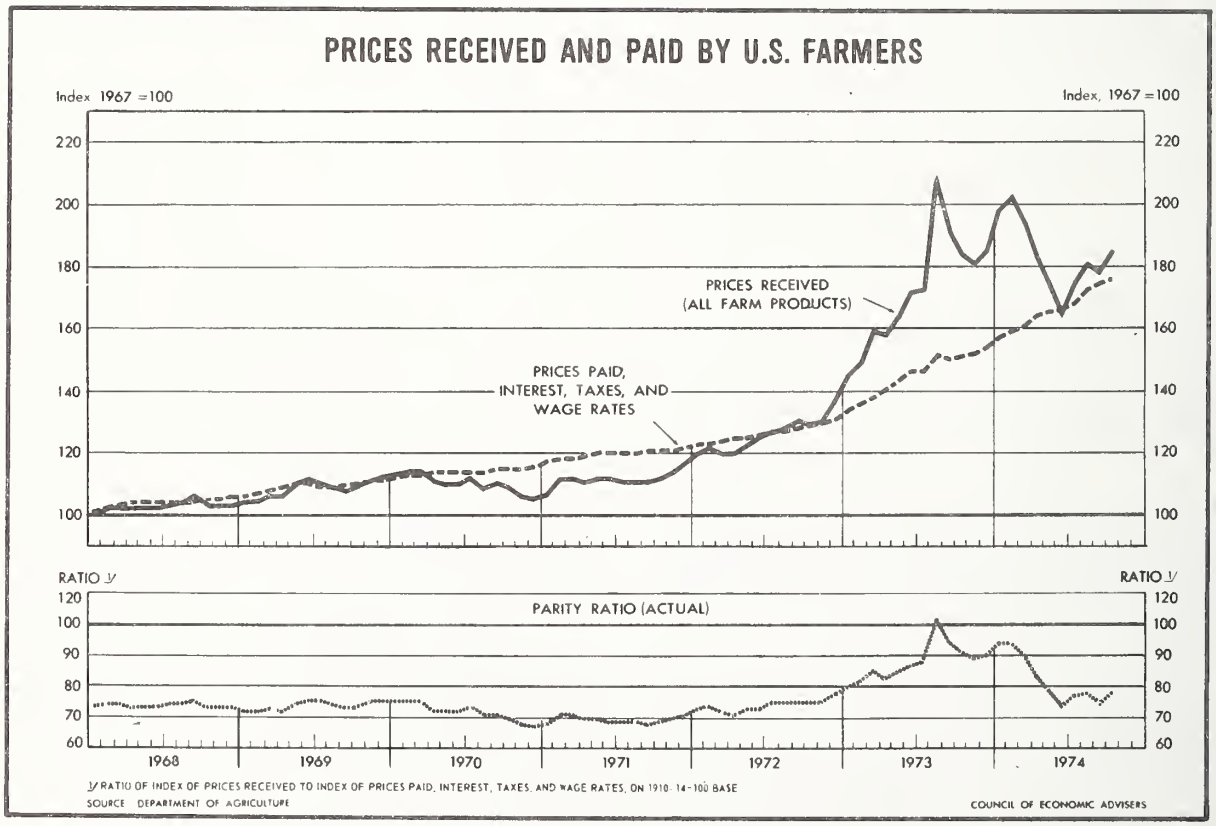


Figure 2

Table 7–Food prices in the OECD consumer price index

Country	Weight of food in CPI	1972 to 1973		March 1973 to March 1974	
		Changes in food prices	Weighted contribution to rise of total CPI	Changes in food prices	Weighted contribution to rise of total CPI
		percent			
Canada	30.8	12.5	51.3	15.3	45.3
United States	22.2	14.5	51.6	18.3	39.8
Japan	43.1	12.4	45.3	25.8	46.3
Australia	36.6	15.3	62.1	19.8	56.2
France	40.2	9.7	53.4	12.5	41.2
Germany	33.3	7.6	36.2	5.1	23.6
Italy	43.3	12.0	48.1	14.4	39.0
United Kingdom	41.6	11.5	52.2	14.4	44.4
Belgium	30.0	8.0	34.3	7.8	24.9
Denmark	36.9	10.8	43.0	13.0	34.8
Ireland	48.1	16.5	69.3	11.1	39.5
Netherlands	35.1	7.3	32.5	7.1	27.1
Austria	39.2	7.5	38.2	7.2	31.4
Finland	39.8	11.2	39.5	9.4	21.1
Norway	35.9	7.2	33.3	7.4	29.1
Portugal	53.8	9.0	37.2	25.2	47.2
Spain	55.2	12.6	61.4	15.2	53.4
Sweden	33.3	6.8	34.3	7.2	22.2
Switzerland	36.0	6.1	25.3	6.4	24.0

Source: OECD, *Economic Survey*, 1974.

Recent Economic Developments Affecting Food

While changing supply conditions—a decline in world food production in 1972 and 1974, the drawdown in food stocks, and major shifts in trade patterns —contributed to the rise in food prices and shortages of food in 1972-74, other economic developments greatly complicated, and in some cases compounded, the problems produced by the supply conditions.

Economic Growth

Although incomes grew significantly during the past decade, unusually rapid economic growth throughout the world during 1972-73 enhanced the demand for food at the very time that supplies were dwindling. Gross national product (GNP) in the developing countries rose, in real terms, at the very rapid annual rates of 6.2 and 7.4 percent in 1972 and 1973. The annual rate for developed countries rose from 3.6 percent in 1971 to 5.5 percent in 1972 and to 6.3 percent in 1973.

Inflation

While demand for food was enhanced by rapid income growth in 1971-73, most countries were also experiencing rapid rates of inflation. Inflation distorts the relationship between present and past prices so it is difficult to appraise how much of an increase there has been in real food prices.[9] Inflation can also distort the relationship between food prices and other prices, thereby inducing people to hold food commodities for speculative purposes.

Even though the rate of inflation was accelerating in the late 1960's, it was especially rapid in 1972-74— as much as 25 percent in some countries. With generally stable prices for most foods and very low prices for grains in 1967-71 and much of 1972 (ch.2), rapid inflation had further lowered the "real" price of these products. For those farmers whose prices were directly affected by these developments, the incentive

[9] In the United States, the consumer price index in mid-1974 was 50 percent above 1967. If food prices shared equally in this general rise in prices they would have been 50 percent higher than they were in 1967 because of inflation alone.

to produce was declining, while for consumers the cost of food was low relative to the cost of other products, and relative to their incomes—which were higher because of real economic growth.

Exchange Rate Adjustments

Much of the increased world food imports that occurred in 1972 and 1973 came from the United States, in part because of the availability of supplies. However, the U.S. dollar was overvalued relative to other currencies in the late 1960's and early 1970's, and the devaluation of late 1971 further reduced the already relatively low prices of U.S. exports. But, because of the availability of surplus U.S. grain stocks, the world price of grains was not affected. The effect of the second devaluation in early 1973 was obscured by the already high prices due to shortrun supply shortages.

The Energy Crisis and Fertilizer

The increases in petroleum prices (from $1.80 per barrel in February 1971 to $11.65 in January 1974) have had repercussions on the world food situation—and many are yet to be felt.

Higher prices for gasoline, diesel, and other petroleum products have raised the cost of producing food in the mechanized agriculture of the developed countries and in those developing countries where petroleum or energy produced from it is used—in tube wells and motorized tillers, for instance. Higher energy costs have also raised the cost of transporting food from farms and transporting inputs to farms. They are, in addition, creating higher costs for tractors, trucks, and other machinery through their influence on the production costs of these inputs.

The most serious effects of higher oil prices on the world food situation, however, are their contribution to the cost of fertilizer and to world monetary imbalances and payments problems engendered by the high costs of importing oil.[10]

World fertilizer production and use rose dramatically in the past two decades and contributed to increased food production and lower food prices. The increased use of fertilizer was a major reason for rapid yield increases in developed countries during this period. It was also an important component of the Green Revolution, which raised wheat yields in Mexico over the past two decades, and wheat and rice yields in South and Southeast Asia in the late 1960's (ch. 8).

Low prices of fertilizer from 1967 to 1973 encouraged its use. Prices were low because of low input costs and rapid technological improvements but also because of substantial overexpansion in the fertilizer industry (ch. 8). Overexpansion and low prices resulted in little plant construction in the late 1960's and early 1970's. By 1972, when the anxiety over food supplies caused expanded crop area in North America and increased needs for fertilizer in developing countries, fertilizer demand began to overtake supply and fertilizer prices began to increase. The rise in grain prices in late 1972 added further impetus to fertilizer demand. Bagged urea rose from $45 per ton in 1971 to over $350 per ton by early 1974. Phosphate prices rose from less than $50 to between $348 and $412 per ton in 1974.

High prices for petroleum, food, and fertilizer place a heavy burden on the developed countries, but the developing countries which are not oil producers and which also import large amounts of fertilizer and food are especially hard hit by high prices for all three. The International Monetary Fund has estimated that the import bill of developing countries for food (largely grain) and fertilizer will rise from $6.4 billion in 1972 to $15.6 billion in 1974. Additional billions for petroleum imports make the import burden prohibitive.

Current Situation and Near-Term Prospects[11]

Efforts to expand food production in many countries in 1974 met with limited success. Favorable weather was experienced in Latin America, Europe, and parts of the USSR. In Africa, the Sahelian drought appears to have been broken, with rainfall near or above average. But the United States, Canada, India, Bangladesh, and parts of the USSR's New Lands regions suffered from adverse weather.

World grain production is estimated to be considerably below 1973 and below the 1960-73 trend. Grain stocks in major grain exporting countries are expected to decline further. Food reserves and supplies in parts of South and Southeast Asia will be lower than in 1973. Thus, 1974/75 will be another year of precarious grain supplies.

World supplies of oilseeds and meals are also down due to a 10-million-ton lower crop in the United States. However, world meat production reached a record high in 1974 as did livestock numbers. Both Japan and the EC temporarily banned meat imports to maintain internal prices for producers.

[10] Higher oil prices are only one factor influencing higher fertilizer prices (ch. 8).

[11] For more detail, see the Sept. 1974 and Dec. 1974 issues of the *World Agricultural Situation*, Economic Research Service, USDA.

An important factor affecting the food situation in 1974, however, is the sharp decline in economic growth which began in late 1973 in many developed countries. During 1974, no real economic growth took place in Japan, West Germany, the United Kingdom, France, and Canada, and real GNP in the United States declined. This is reducing some of the demand pressure on food and if it continues, could have a significant effect on future food demand. Extremely high food prices are also reducing consumption.

The present world food situation is serious and it is impossible to predict the success or failure of crops in the next year or two. The problems that exist now and are the center of so much concern can be expected to persist until there is an improvement in production. Among the many problems, the following are the most critical:

(a) Grain stocks are very low and cannot be rebuilt until production increases. Any further deterioration in grain production next year would further worsen the situation.

(b) High grain and food prices and reduced food aid have worsened the conditions of the world's already malnourished because those with higher incomes are better able to command the available supplies.

(c) Fertilizer supplies for at least the next few years probably will continue to be limited and prices high until production capacity is increased.

(d) Chronic food deficit areas, such as India and Bangladesh, and areas affected by exceptional food shortages, such as central Africa, are experiencing more serious difficulties because of high prices for food, fertilizer, and petroleum.

These conditions have given rise to a variety of proposals for emergency measures, some of which imply the need to allocate food and fertilizer on some other basis than that which presently exists. Although these issues are not the central concern of this study, many of them are dealt with in various places in the report. While scarcity and high prices of food and fertilizer present very real and serious problems today, these can be corrected relatively soon unless the world experiences an unpredictable series of crop failures.

Some combination of emergency measures to alleviate current problems is needed, but one painful lesson of the present situation is that when food scarcity conditions are permitted to develop, the options for short-term solutions become very limited. Significant improvements cannot come about unless there is a deliberate transfer of food, or the resources to produce it, from those who have them to those who do not. How large such a transfer should be, from whom it should come, to whom it should go, and how it should be handled are moral and political decisions which are not easily made. It is quite unlikely that these decisions will be able to do more than alleviate the most pressing immediate problems. This prospect lends further weight to the need to develop more fundamentally sound long-run food policies which ensure that the food production capacity of the world's poor is improved and that the security of the world against supply disruption is better assured.

Major Problem Areas in the Developing Countries

Sahel and Ethiopia

During 1972 and 1973, drought affected large areas of West Africa, the Sudan, and Ethiopia. In 1973, the drought in the six Sahelian countries of West Africa—Chad, Mali, Mauritania, Niger, Senegal, and Upper Volta—spread to northern Nigeria, northern Cameroon, and parts of Kenya and Tanzania. Food shortages caused by the drought resulted in widespread and severe famine, particularly in the Sahelian countries and Ethiopia. Although the number of deaths from famine in the Sahel and Ethiopia cannot be accurately determined, thousands of people have died. Livestock deaths have also been substantial.

In the short run, the Sahelian countries and Ethiopia will require continued famine relief. Although rains were near normal in 1974, it will take a year or more to rebuild depleted food supplies.

India and Bangladesh

In addition to having shortfalls in food production, India and Bangladesh have limited ability to pay for high-cost imports of food, fertilizer, and oil. India is already using up its food reserves, and supplies are likely to be short through 1976, particularly if grain production fails to increase

Bangladesh's external financial position is quite weak since foreign exchange reserves were depleted in 1973 by the commercial purchase of over a million tons of wheat. Bangladesh has limited foreign exchange to pay for costly grains, fuel, and fertilizer, and thus the current high prices of inputs critical to expanded agricultural output will dampen food production growth. Flooding in the south in 1974 only exacerbated the situation and resulted in the need for large-scale food aid this year.

2. LONG-TERM TRENDS IN FOOD PRODUCTION, CONSUMPTION, TRADE, AND STOCKS

The vulnerability of the world to the disruptions in food supply in 1972-74 was influenced by how production and consumption had developed over the previous two decades and how governments had responded. Three trends were especially important: the increasingly larger gap between food production and food needs in developing countries—the "world food gap"; sporadic but growing grain import deficits of the centrally planned economies; and persistent food surpluses in some developed countries. Behind these trends were a number of associated developments:

—slow growth in per capita food production in developing countries and their reliance on food aid and on food imports in periods of production shortfalls.

—the tendency for the developed countries both to become more self-sufficient in food and to capture more of the world food export market.

—the trend downward in real food and fertilizer prices, especially in 1967-71, which contributed to increased use of grain for livestock feed, increased grain exports, and to a sense of abundance of both food and fertilizer.

—the existence of a variety of government incentives to agricultural production in the developed countries, which started leading to surpluses in the mid-1950's. Then, from 1967 on, efforts to eliminate these surpluses led to a slowdown in developed countries' food production and to a reduction in their food stocks.

—various disincentives to food production in developing countries until introduction of Green Revolution technology provided an impetus for farmers to produce more food. As a result, output rose in developing countries in the late 1960's but the incentives have since been relaxed.

Food Production Trends

During the two decades between 1954 and 1973, food production declined on a global basis only once—in 1972—although in the developed countries it declined in 1961, 1969, and 1972. World food production rose a total of 69 percent (based on trend values) over these decades, 65 percent in the developed countries and 75 percent in the developing countries.[1] World food production increased faster than population: the trend rate of increase was 2.8 percent for production and 2.0 percent for population, resulting in an annual increase in world per capita food production of 0.8 percent.

Total and annual increase in food production, population, and per capita food production, 1954-73

	Total increase 1954-1973	Annual rate of increase
	percent	
Food production		
World	69	2.8
Developed countries	65	2.7
Developing countries	75	3.0
Population		
World	44	2.0
Developed countries	22	1.0
Developing countries	61	2.5
Per capita food production		
World	17	0.8
Developed countries	33	1.5
Developing countries	8	0.4

Based on linear trends computed from data in Table 1.

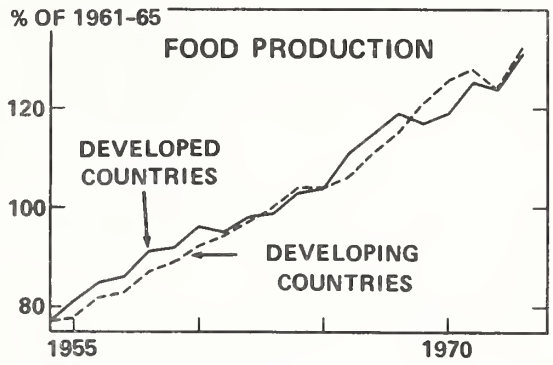
These trends show that, *on the average*, the 3.8 billion people in the world in 1973 had about one-fifth more food to eat per person than did the 2.7 billion people in 1954. But because of sharply different population growth rates, food production per capita rose at an annual trend rate of only 0.4 percent in the developing countries, compared with 1.5 percent in the developed countries (fig. 3).

Most of the people in the world live in developing countries, where most of the world's annual increase

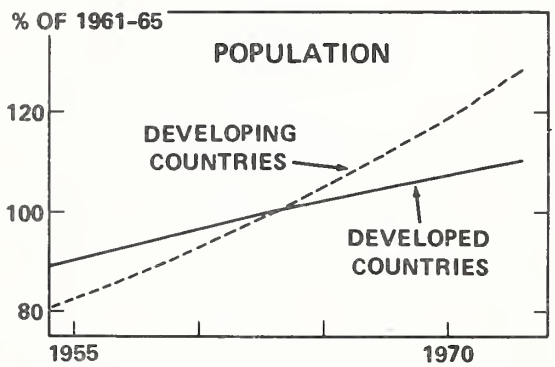
[1] In this discussion, the "world" excludes the Asian centrally planned economies, for which data are lacking. These countries are included in other parts of the discussion, but excluded here, where the effect of arbitrarily attaching values to estimates of production and population could give spurious results. "Developed countries" here includes the centrally planned economies of the USSR and Eastern Europe and "developing countries" excludes the Asian centrally planned economies.

FOOD PRODUCTION AND POPULATION, DEVELOPED AND DEVELOPING COUNTRIES

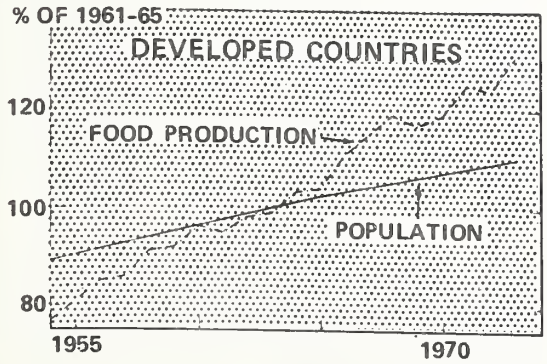
Food production has grown steadily over the past two decades. Growth in the developing countries has roughly paralleled that in the developed countries.

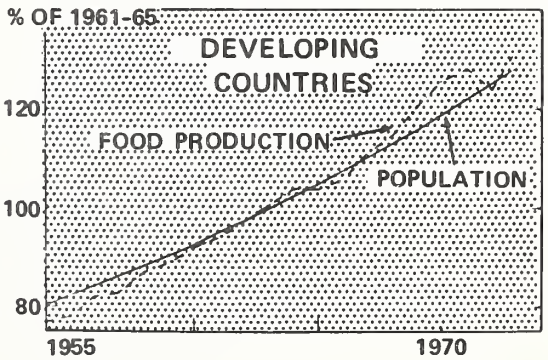


Population has grown much faster in the developing countries.



Peoples of the developed and developing country groups have not fared equally from the roughly equal growth in food production. In the developed countries production has increased much faster than population, boosting production per capita. In the developing countries, population gains have absorbed nearly all of the production increase; production per capita has improved only slightly.





DATA EXCLUDE COMMUNIST ASIA

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FIGURE 3

in population occurs (ch. 9). Population growth in the developed countries fell from 1.3 percent in 1961 to just under 0.9 percent in 1973. The developed countries were adding only 9.6 million people to the world's annual population increase of 71 million in 1973. In the developing countries, population is now growing more than 2.5 percent annually, compared with 2.0 percent in 1950.[2] These countries now add almost 48 million to the world's population each year, nearly double their annual additions in the early 1950's and five times the current increment of the developed countries. China and other Asian centrally planned economies add an additional 13.4 million persons per year, and their population growth rate of 1.7 percent is presumed to be declining gradually. The developing countries, including Asian centrally planned economies, now account for 86 percent of the world's annual population increase.

Most of the major developed country regions have shown a strong uptrend in per capita food production (fig. 4). During 1954-73, the steepest increases took place in Eastern Europe and the USSR, part of which was recovery from the very low production levels prevailing prior to 1954.[3] The slowest growth in per capita food production among developed regions occurred in the United States and Canada, where parts of agriculture, especially the grain sector, were being constrained by government policies designed to avoid further accumulations of already large agricultural surpluses, and, in the late 1960's, by low farm prices. In the USSR, Canada, and Oceania, variations in weather caused wide year-to-year fluctuations in agricultural production around the 1954-73 upward trend.

With the exception of Africa, most major developing regions experienced a substantial improvement in per capita food production during the last half of the 1960's, a period associated with the Green Revolution. In Africa, a general downward trend has been experienced since 1961.[4]

The value of food production per capita in the developed countries is more than five times as large as in the developing countries (fig. 5). This difference reflects the higher level of income in developed countries—which permits consumption of higher value food products such as meat, milk, and eggs—and the much higher level of agricultural productivity per person.

[2] Excludes Asian planned economies.

[3] In the USSR, for example, total agricultural production in 1953 was at the same level as in 1913, a result of four decades of revolution, collectivization, and World Wars I and II.

[4] Many of the estimates of population and food production in Africa, however, are based on very inadequate data and may not be as reliable as those of other regions.

Grain Production Trends

Total world grain production (all grains and paddy rice) rose from 920 million to 1,320 million tons from 1961 to 1973 (fig. 6). World grain area, however, grew very slowly—from 665 million hectares in 1961 to nearly 700 million hectares in 1973. The world grain area did not increase significantly from 1967 to 1973, partly because of a cutback in the grain area of major grain exporting countries.[5]

At the world level, grain production increased 3.0 percent annually over the period 1960-62 to 1969-71, faster than the 2.0 percent rate of population growth, while area increased only 0.4 percent (table 8). Higher yields accounted for most of the increased production. Yields of all grains increased from 1.4 to 1.8 tons per hectare.

Growth rates in grain area, yield, and production in major world regions and selected countries during the past decade exhibit significant differences (table 8). Among the developed countries, for example, Japan reduced its grain area at an annual rate of 3.5 percent, and Australia and New Zealand increased theirs by 3.6 percent. While Japan's grain yields increased 1.3 percent annually, those of Oceania made little progress (0.2 percent). Among the developing countries, East Asia and East Africa increased both their yields and area substantially, giving them annual production increases of 4.8 and 5.6 percent, respectively. Other developing regions increased production at close to or better than 4 percent per year, but almost exclusively through area increases. India and North Africa, where land suitable for crops is limited, had better yield increases than did many developing countries, but these were not sufficient to keep production increases from falling behind expanding consumption.

A serious problem in the developing world, but also an indication of the potential for improvement, is the low level of rice yields, which are much lower than those in the developed countries (fig. 7). Paddy yields in the developed countries averaged 5 tons per hectare in the first half of the 1960's and rose to 5.5 tons in the last part of the decade. But in the developing countries, where 92 percent of the world's rice is produced and consumed, yields barely exceeded 1.5 tons per hectare during much of the 1960's. While they rose to nearly 1.8 tons in 1970, they have since fallen, largely because of poor weather.

A large part of the world's population—close to 2 billion people—is concentrated in the rice producing and consuming center of the world (which includes Bangladesh, India, Indonesia, Pakistan, and the People's Republic of China) (ch. 9). With the exception

[5] Grain acreage expanded in a number of countries in 1974, but FAO world totals for grain acreage in 1974 are not yet available.

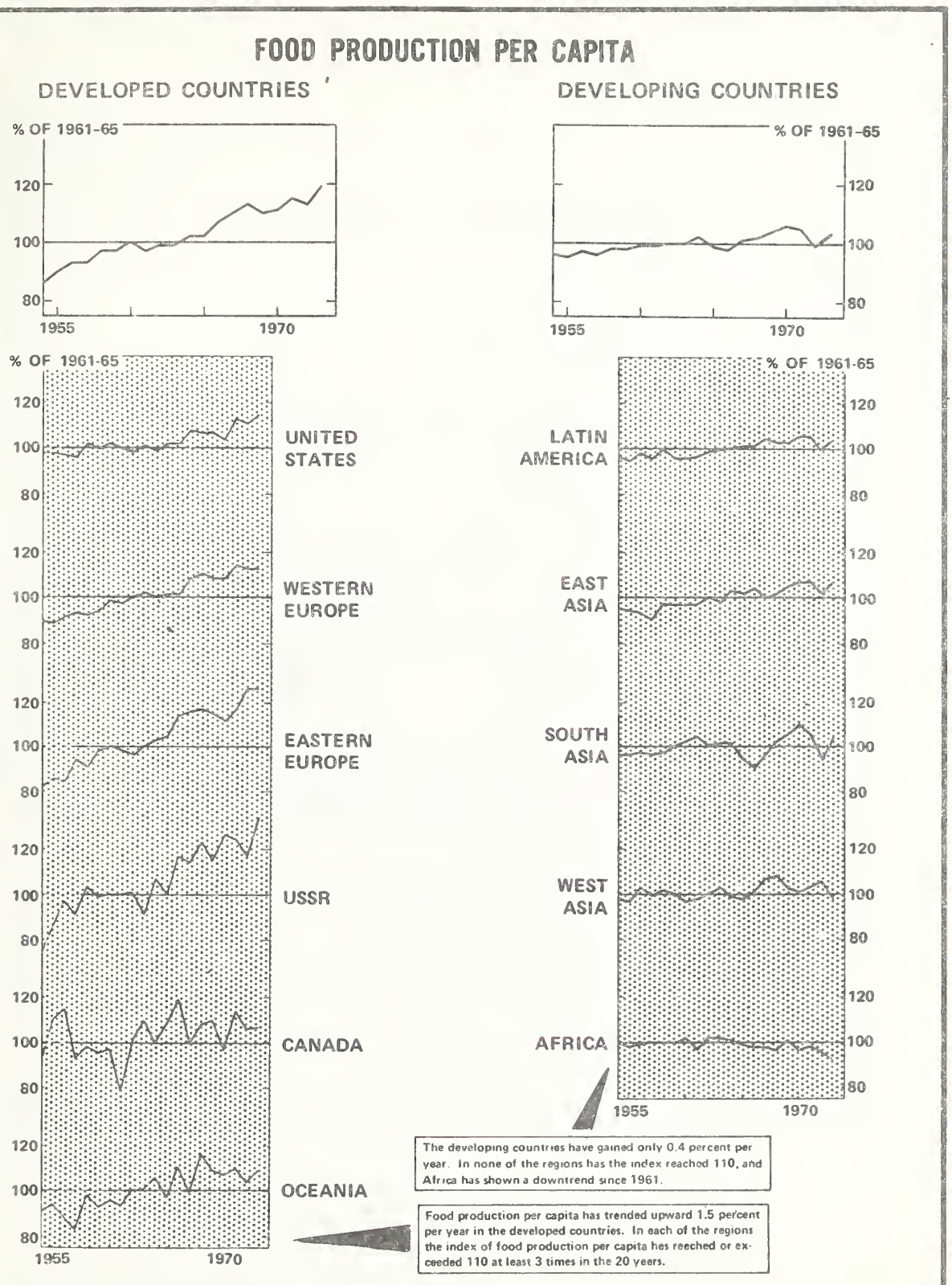

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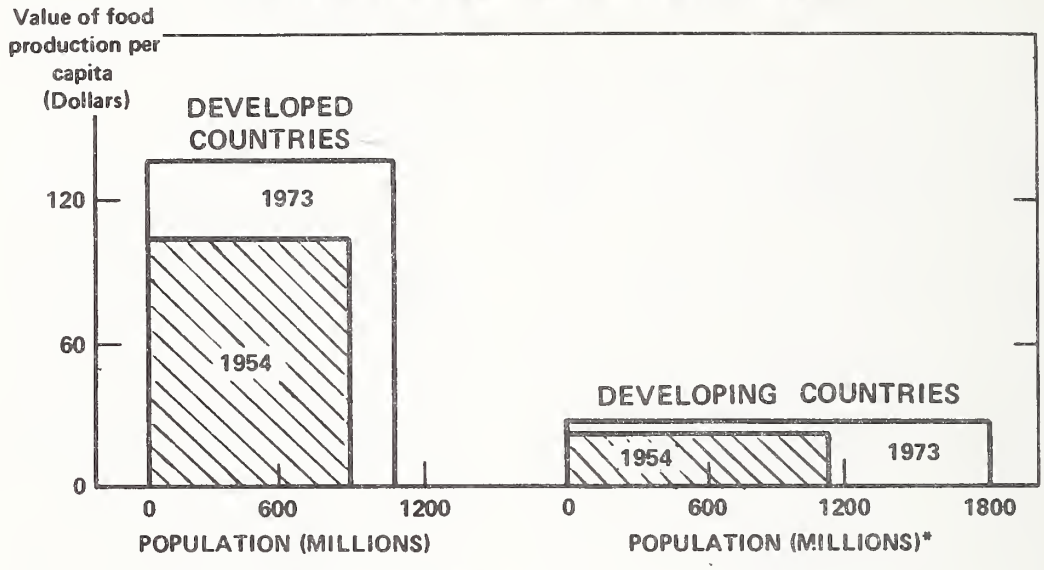
FIGURE 4

POPULATION AND FOOD PRODUCTION



*Population excludes Communist Asia

In this chart the area of each rectangle, determined as the product of population (measured on the horizontal axis) times value of food production per capita (in dollars on the vertical axis), represents the total value of food production in million dollars for an indicated group of countries at a specified time. All four rectangles may be compared in height, in width, and in area. (Values computed at 1961–65 average prices.)

1. Developed countries in 1973 accounted for:
   a. Two-fifths of world population
   b. Three-fourths of world food production
   c. Three-fourths of the increase in world food production since 1954
   d. One-fourth of the increase in world population since 1954

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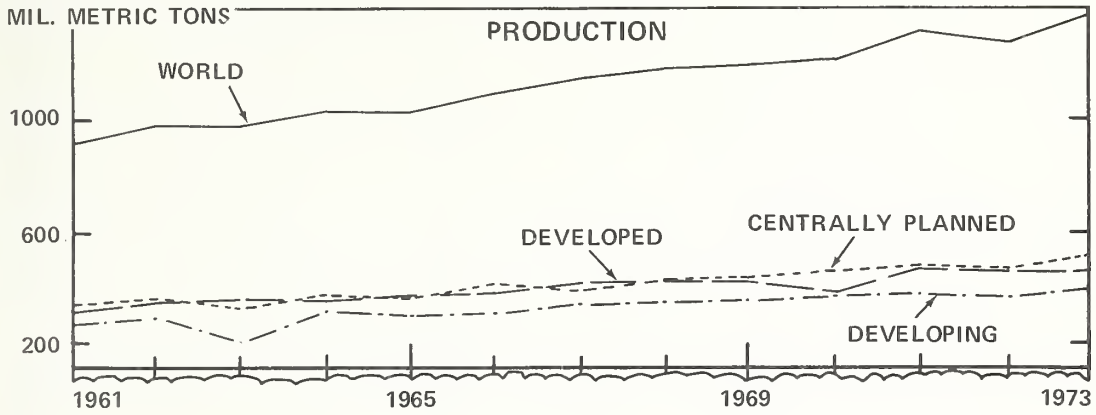
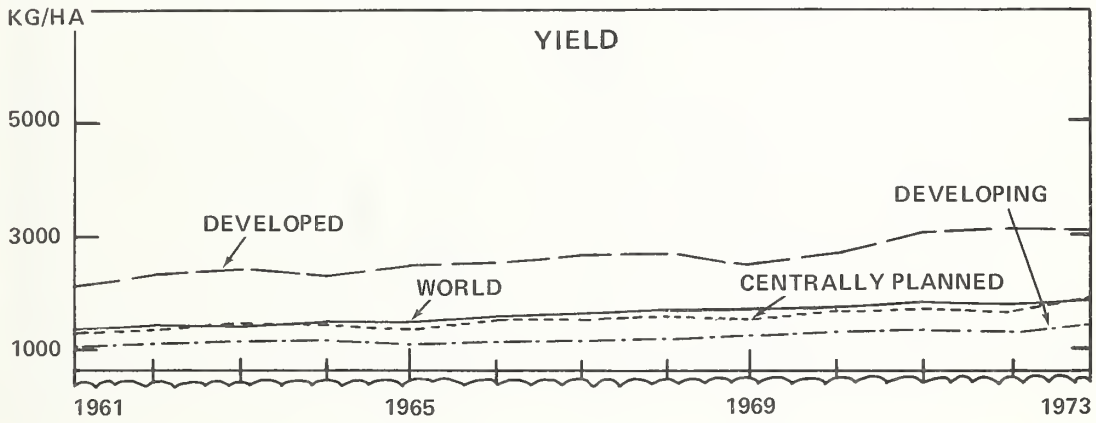
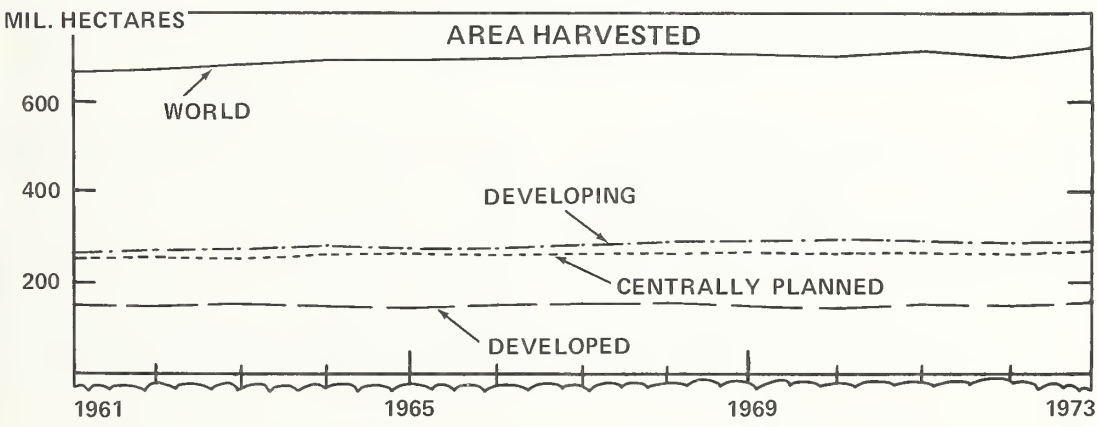
Figure 5

WORLD GRAIN PRODUCTION, YIELD, AND AREA, 1961-73







SOURCE: FAO PRODUCTION YEARBOOK. RICE INCLUDED AS PADDY AS WELL AS MINOR AND MIXED GRAINS. 1961-72 FAO PRODUCTION YEARBOOK, VOLUME 26. 1973 FAO MONTHLY BULLETIN OF AG. ECONOMICS & STATISTICS, VOLUME 23, MAY 1974.

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Figure 6

Table 8–Growth rates in factors affecting grain production and consumption

Country	Area	Yield	Pro-duction	Con-sumption	Popu-lation	Income[1]
	Compound rate of growth, 1960-62 to 1969-71					
Developed countries	-0.1	2.8	2.7	2.5	1.1	4.4
United States	-1.0	3.4	2.4	2.1	1.3	3.9
Canada	0.0	3.3	3.3	2.9	1.8	4.0
EC	0.7	2.5	3.2	2.2	0.7	3.7
EC 6	-0.2	3.3	3.2	2.2	0.8	4.2
EC 3	2.1	1.3	3.4	2.1	0.5	2.6
Other West Europe	0.2	3.5	3.8	3.5	0.9	5.1
South Africa	3.2	1.1	4.2	4.5	3.0	5.7
Japan	3.5	1.3	-2.2	3.3	1.1	9.8
Australia & New Zealand	3.6	0.2	3.7	3.9	2.0	4.2
Centrally planned countries	0.0	3.0	3.0	3.4	1.4	5.2
East Europe	-0.6	3.7	3.0	2.9	0.6	4.5
USSR	-0.1	3.4	3.3	4.3	1.3	6.5
China (PRC)	0.5	2.2	2.7	2.6	1.8	2.7
Developing countries	1.4	1.9	3.5	3.7	2.6	4.6
East Asia	1.6	3.1	4.8	5.6	2.4	4.3
Indonesia	1.3	2.0	3.6	3.7	2.5	2.0
Southeast Asia	1.3	2.2	3.6	5.0	2.6	3.9
South Asia	1.3	2.2	3.2	3.1	2.6	3.4
India	1.0	2.0	3.0	3.4	2.6	3.3
No. Africa/Middle East	0.6	2.4	3.1	3.9	2.7	6.2
Central Africa	3.5	-0.5	3.0	4.4	2.4	2.9
East Africa	5.0	+.5	5.6	5.7	2.5	4.1
Mexico/Central America	2.7	3.0	5.7	5.6	3.3	6.5
Venezuela	4.9	0.6	5.5	7.8	3.0	5.4
Brazil	5.0	0.0	5.0	4.3	2.9	7.0
Argentina	2.6	1.7	4.4	3.2	1.5	4.1
Other South America	0.2	1.8	2.1	3.2	2.8	3.8
World	0.4	2.6	3.1	3.3	2.0	4.6

[1] Private consumption expenditures calculated for 1960-70 in constant 1970 dollars.

Source: Foreign Agricultural Service and Economic Research Service for area, yield, production, and consumption data; U.N. for population and income data.

of Indonesia, these countries have serious land expansion constraints (ch. 8). While rice yields have increased in these countries since 1965 as a result of the Green Revolution, they are still far below those of developed countries. The difficulties of increasing rice yields in these countries are one of the major problems slowing food production in the developing world.

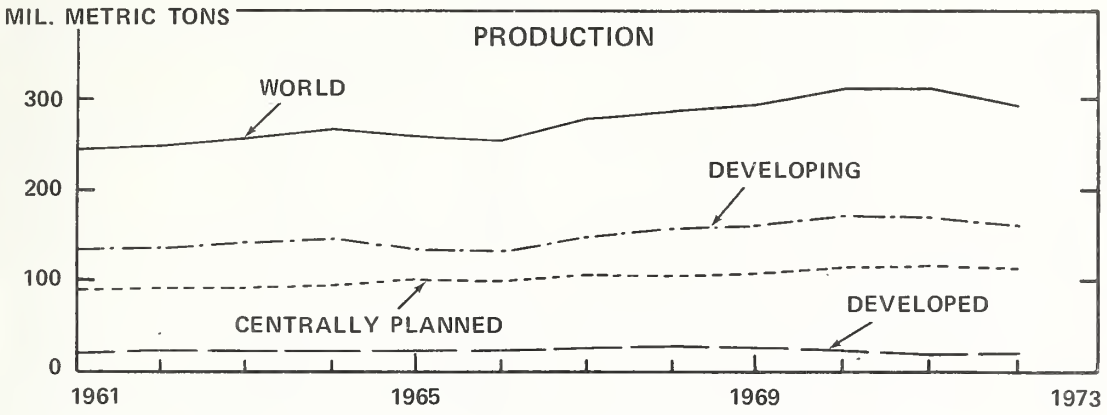
Trends in World Agricultural and Grain Trade

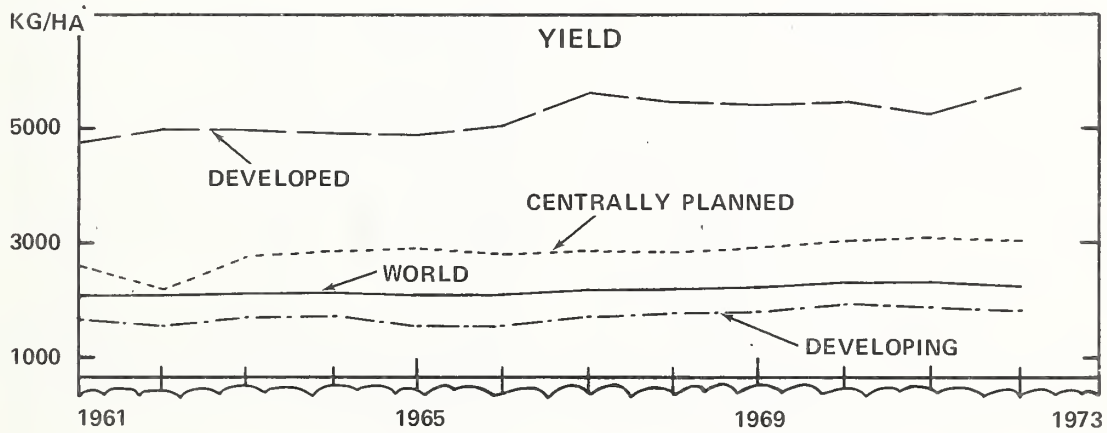
Trade among the developed countries, both total and agricultural, has increased substantially over the past two decades. In 1955, 45 percent of total world trade and 35 percent of world agricultural trade took place between the developed countries. By 1972, these percentages had increased to 57 and 49.

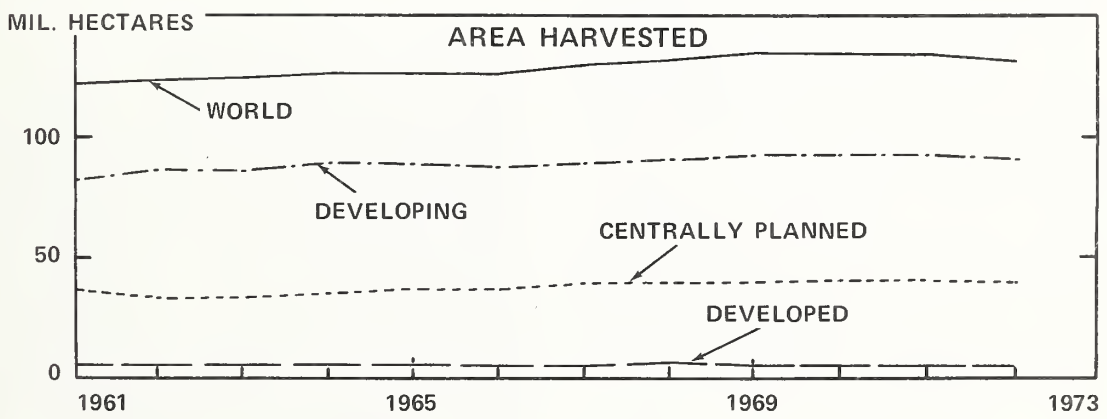
The developed countries also account for an increasing proportion of total and agricultural exports. They provided 65 percent of total exports and 45 percent of agricultural exports in 1955, and 73 and 61 percent, respectively, in 1972. The developing countries' share of total and agricultural exports fell from 25 and 45 percent in 1955 and to 16 and 28 percent in 1972.

The share of the developed countries in world grain exports has also become larger (table 9). In 1956-60, the developed countries exported 61 percent of the world's grain exports, and this proportion increased to 83 percent in 1972, in part as a result of the extra-

WORLD RICE PADDY PRODUCTION, YIELD, AND AREA, 1961-73







SOURCE: FAO PRODUCTION YEARBOOK, VOL. 26, 1972.

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Figure 7

Table 9—Matrix of world grain trade

Exporting regions \ Importing regions	Developed	Developing	Centrally planned	World
		percent distribution		
Developed				
1956-60	40.6	18.2	2.3	61.3
1961-65	39.2	20.4	11.8	71.4
1966-70	41.7	22.3	8.3	72.3
1971	42.5	23.6	7.2	73.3
1972	44.9	22.8	15.1	82.8
Developing				
1956-60	10.2	11.9	0.7	22.8
1961-65	7.7	9.7	2.5	20.1
1966-70	7.8	7.9	2.0	17.7
1971	8.5	6.1	1.0	15.6
1972	3.9	6.7	0.6	11.3
Centrally planned				
1956-60	3.3	2.0	10.6	15.9
1961-65	2.2	0.8	5.5	8.5
1966-70	1.9	3.0	5.1	10.0
1971	1.2	2.6	7.3	11.1
1972	0.8	1.3	3.7	5.9
World				
1956-60	54.1	32.1	13.6	100
1961-65	49.1	30.9	19.8	100
1966-70	51.4	33.2	15.4	100
1971	52.2	32.3	15.5	100
1972	49.7	30.8	19.4	100

Note: The column headings are importing regions while the table stub on the far left shows the exporting regions. Thus, by reading down one obtains imports by the region listed and by reading across one obtains obtains exports.

Source: United Nations, *Monthly Bulletin of Statistics*, Sept. 1974 and selected issues.

ordinary imports of the USSR. Over the period, the developing countries' share dropped from 22.8 to 11.3 percent, and that of the centrally planned countries, from 16 to 6 percent.

Thus, over the past two decades and especially during the 1960's, the developing and the planned economies have come to depend more on the developed countries for grain supplies. The developing countries' imports have become progressively larger, and the intermittent imports of the centrally planned economies have also grown (tables 10 and 11).

Among the developed countries, Europe and Japan also depend heavily upon the major grain exporting countries—Australia, Argentina, Canada, and the United States.[6] However, there is a high degree of stability in the imports of Europe and Japan. A large part of these imports are for livestock feed, and both Europe and Japan are economically well able to afford such imports. Grain imports by Europe have stabilized since 1960-62 because farm policies in the EC, as well as those in some non-EC countries, have raised grain producer prices inside Europe to a level that has stimulated rapid yield and production increases (table 8). Thus, while grain use in Europe has increased, largely for livestock feed, imports have not. Japan's grain imports have risen dramatically, with coarse (feed) grains accounting for much of the growth. High levels of price protection have made it possible for Japan to maintain self-sufficiency in rice production.

These shifts in world grain trade were not troublesome to the world or the developed grain exporting countries during the 1960's, when grain surpluses and stocks were large. Concessional sales to developing

[6] Eastern Europe's imports shift from the USSR to the major exporters when the USSR's supplies are limited.

Table 10—Wheat net trade

Year	Developed	Developing	Centrally planned
	million metric tons		
1960/61 - 1962/63 ave.	+21.6	-13.0	-4.5
1969/70 - 1971/72 ave.	+28.8	-22.1	-3.7
1971/72	+30.9	-24.6	-5.1
1972/73	+45.6	-21.7	-22.6
1973/74	44.8	-30.7	-9.2

Source: Economic Research Service/Foreign Agricultural Service.

countries served development purposes and also made it possible to reduce costly domestic surplus stocks. Purchases by the planned economies were advantageous commercial sales which further reduced stock buildups from time to time. Now, however, with low grain stocks in exporting countries, high grain prices, and reduced grain supplies for food aid shipments, the rising dependence of the developing countries and the planned economies on grain imports takes on a different meaning. The deficits of the developing countries are for food grains—wheat and rice. In the past, about half of this deficit was supplied under concessional (food aid) arrangements. For a number of the major food deficit developing countries, commercial imports were difficult to finance even at earlier, lower prices.

The imports of the planned economies are also largely food grains—wheat—although coarse grains have become increasingly important. While these are commercial grain imports, sharp year-to-year fluctuations in the amounts imported are a major destabilizing influence on world grain supplies and prices.

Production Adjustments and Stock Changes

In the face of the increasing world "food gap" and rising import demands by the planned economies, much attention has been focused on the relatively slow growth of world grain production in the past half decade and on the decline in world grain stocks.

In the 14 years between 1960/61 and 1973/74 annual production of the six major grains (excluding rice) exceeded or equaled annual consumption in 8 years. But in 3 of the past 5 years, annual consumption has exceeded annual production, with the excess over the period totaling 53 million tons (table 12).

The USSR had three major grain production shortfalls between 1960 and 1973. Production fell by 33 million tons in 1963, by 31 million tons in 1965, and by 13 million tons in 1972, with the shortfalls contributing significantly to lowered world production in all 3 years. Prior to 1963, the Soviet Union absorbed grain production shortfalls internally by stock drawdowns, reduced human consumption of grains, and slaughter of livestock. But large grain imports were made to partially offset the 1963 and 1965 crop shortfalls, and 1972-73 imports were far more than enough to compensate for the 1972 shortfall.

India's 1965 and 1966 shortfalls in cereal production coincided with the 1965 Soviet shortfall and contributed to the high export levels in those years and the rapid drawdown in world stocks in 1966-67. China also increased grain imports in the mid-1960's.

Concern about an approaching world food shortage in the mid-1960's stimulated expanded grain production in the grain exporting countries, rapid development of fertilizer production capacity, and a heavy drive to expand production in some developing countries with Green Revolution technology.

These efforts produced dramatic results. Combined with recovery in the USSR and China, large increases in world grain production took place in 1966-68, and production exceeded consumption in those years. Stocks reached a peak of 191 million tons at the beginning of the 1969/70 marketing year. In response to this, the major grain exporting countries began to cut back grain production, especially wheat. Between 1968 and 1970, the combined wheat area of the United

Table 11—Coarse grain net trade

Year	Developed	Developing	Centrally planned	Japan	EC9	Other West Europe
			million metric tons			
1960/61 - 1962/63 ave.	+1.6	+3.3	+0.8	-2.4	−14.3	-2.1
1969/70 - 1971/72 ave.	+.9	+5.4	-3.3	-10.3	-13.2	-4.0
1971/72	+9.1	-0.5	-8.2	-10.3	-12.2	-3.8
1972/73	+14.7	+1.1	-10.7	-12.1	-12.5	-5.0
1973/74	+12.9	+2.7	-8.2	-14.1	-13.4	-8.2

Source: Economic Research Service/Foreign Agricultural Service.

Table 12–World grain supply and distribution[1]

Marketing year	Area harvested	Yield	Beginning stocks[2]	Production	Total exports	Consumption total[3]
	million hectares	*quintals/ hectare*		*million metric tons*		
1960/61	473.5	13.9	169.8	657.0	69.9	640.6
1961/62	466.9	13.4	182.7	624.2	80.8	648.1
1962/63	468.0	14.3	156.0	671.3	78.0	664.8
1963/64	475.1	13.9	159.6	661.7	94.1	664.5
1964/65	480.0	14.5	154.8	696.3	92.4	686.0
1965/66	476.3	14.7	157.7	701.9	108.1	734.7
1966/67	475.6	16.2	122.2	771.1	100.0	744.1
1967/68	485.7	16.2	151.1	785.6	97.4	767.4
1968/69	491.1	16.7	163.1	822.4	89.7	794.4
1969/70	487.4	16.9	191.3	825.7	102.1	839.3
1970/71	476.1	17.3	168.6	823.7	109.2	855.5
1971/72	484.4	18.8	131.5	911.4	111.2	892.8
1972/73	479.4	18.5	149.3	888.1	141.8	925.4
1973/74	499.6	19.4	108.1	970.4	151.0	959.5

NOTE: Includes wheat, rye, barley, oats, corn and sorghum.

[1]Data in this table are based on an aggregate of differing local marketing years, and will therefore differ from July-June data appearing elsewhere in this report. [2]Stocks data are only for selected countries and exclude such important countries as the USSR, the People's Republic of China, and part of Eastern Europe, for which stocks data are not available; the aggregate stock levels have, however, been adjusted for estimated year-to-year changes in USSR grain stocks. [3]For countries for which stock data are not available, or for which no adjustments have been made for year-to-year changes, consumption estimates assume a constant stock level. [4]Preliminary.

Source: Foreign Agricultural Service and Economic Research Service, *Grain Data Base,* Nov. 1974.

States, Canada, Australia, and Argentina fell from over 50 million to 33 million hectares and production fell from over 80 million to less than 60 million tons (fig. 8). Had these four countries maintained the wheat area they had in 1967 or 1968, they would have produced over 90 million tons more wheat than actually was produced from 1968 through 1972.

Reduced wheat area in the major grain exporting countries helps to explain why world wheat area stagnated after 1967. This has contributed to the impression that limitations on land availability or production capability have hampered food production growth.

While the major grain exporting countries were responding to overproduction, the USSR, several European countries, and Japan continued to expand output. In Asia, rice production made especially rapid progress between 1966 and 1971, with world output rising from 170 million to 204 million tons (milled). Part of this growth was due to the Green Revolution in Indonesia, the Philippines, India, and Pakistan. But growth in rice production was also rapid in Japan. By 1971, Japanese rice stocks totaled 7 million tons, the largest on record. These stocks were quickly reduced through subsidies for exports, area reductions, and converting rice to feed. Slower growth in rice production in South and Southeast Asia after 1970 was partly made up through imports of wheat.

Thus, in the late 1960's and early 1970's, the grain exporting countries and Japan were adjusting their domestic agricultural policies to curtail production of food grains—wheat in the United States, Canada, and Australia, and rice in Japan—and to reduce their stocks of these grains. These adjustment policies were effective. Stocks were reduced and some of the area in food grains was transferred to coarse grains.

The prices of food and feed grains were especially low during 1967-71. The combined effect of the cutbacks in production and the stimulus to consumption from low prices contributed to the heavy feeding of grain to livestock, the excess of consumption over production, and the large exports and the drawdown in stocks by 1972.

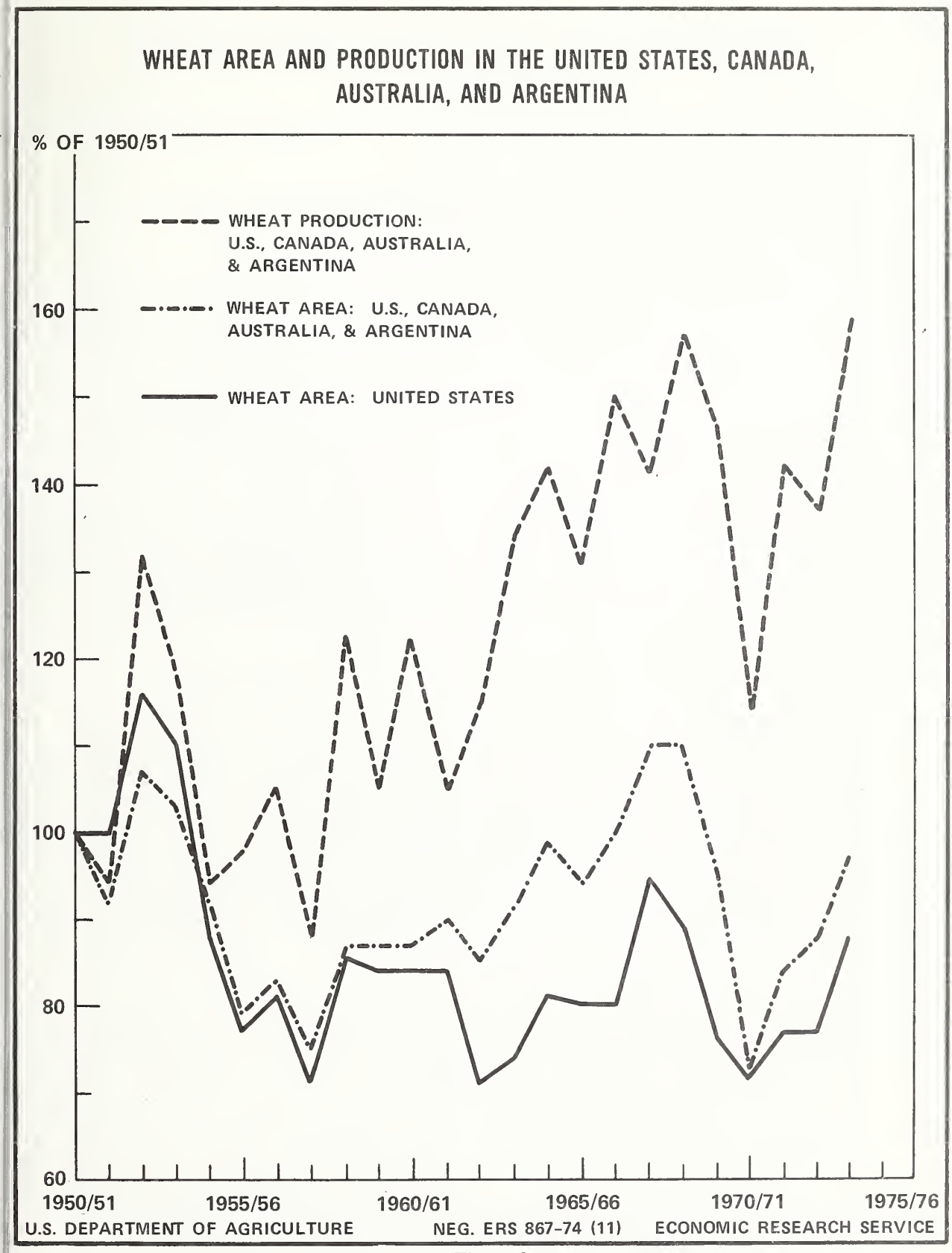
WHEAT AREA AND PRODUCTION IN THE UNITED STATES, CANADA, AUSTRALIA, AND ARGENTINA
% OF 1950/51
WHEAT PRODUCTION: U.S., CANADA, AUSTRALIA, & ARGENTINA
WHEAT AREA: U.S., CANADA, AUSTRALIA, & ARGENTINA
WHEAT AREA: UNITED STATES
160
140
120
100
80
60
1950/51
1955/56
1960/61
1965/66
1970/71
1975/76
U.S. DEPARTMENT OF AGRICULTURE
NEG. ERS 867-74 (11)
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Figure 8

3. TRENDS IN FOOD PRICES AND PRICE POLICIES

World export prices for several major agricultural commodities were relatively stable between 1955 and 1972, and then began increasing at extraordinary rates (fig. 9). From 1972 to 1974, prices of many agricultural commodities doubled and some tripled (ch. 1).[1] The increases have been especially great for oilseed cake and meal, wool, cocoa, rubber, wheat, corn, oilseeds, rice, and sugar (ch. 1).

The stability and level of "international" grain prices are not reflected in the prices faced by consumers and producers in different countries. In many countries, subsidies, taxes, and various agricultural and trade policies to a considerable extent insulate domestic prices from international prices. Differences in prices between countries explain much of the sluggish growth in production since 1968, the levels of grain feeding to livestock, and the level of grain imports.

The United States

While export unit values of grains were relatively stable during much of the past two decades, grain prices in the United States until recent years were declining (tables 13 and 14). In current prices, wheat at the farm level declined fairly steadily from 1954 through 1971, and was especially low during 1967-71. The $4.00 per bushel price in 1973 (current price) was unprecedented. A roughly similar pattern prevailed for corn, although prices dropped to $1.00 per bushel as early as 1960.

Deflated prices, however, show that the decline in real prices began in 1948, and that there was a sharp drop in 1967. The 1973 wheat price in real terms, although still high, was close to that which prevailed in the late 1940's and early 1950's. The real prices of wheat and corn during 1967-71 were exceptionally low compared with those of any earlier period except the early 1930's. The real price of beef, however, was rising, and hay prices were also relatively stable or did not decline as much as grain.

The low prices of wheat and corn, compared with those of beef and hay, led to more grain fed to beef and more wheat diverted to feed use during 1967-72. While prices to grain users fell to very low levels, the returns per bushel of wheat and corn received by farmers who received Government payments did not (figs. 10 and 11). The United States adjusted its farm policies in the mid-1960's from supporting farm prices to providing farmers direct payments. In 1964, the support price for wheat was lowered from $2.00 to about $1.25 per bushel—which was closer to the world price level. Farmers were paid the difference between that price and roughly what they had been receiving. U.S. farmers were thus receiving a fairly constant nominal price of $2.00 per bushel of wheat, while grain users, including livestock feeders, were reacting to much lower prices, as were importers of U.S. grain.

Japan and Europe

Both Japan and the EC countries operate systems that maintained farm prices far above the world price levels prevailing up to 1972. The Japanese average domestic farm price of rice, at $390 per ton during 1968-71, was nearly two and a half times the "world" price during that period. In 1972, at $400 per ton, it was nearly three times the "world" price ($148/ton). Having risen to $636 per ton in 1973, the Japanese price was still above the unprecedented level that "world" rice prices reached in late 1973 and early 1974 (ch. 1).

In the Common Market, the combined effects of the 1971 and 1973 devaluations of the U.S. dollar and the EC variable import levy system (which operates to raise import prices to the level prevailing in the EC) were such that the doubling of U.S. wheat export prices from 1971 to 1972 had practically no effect on farm or consumer prices.[2] When the international price of wheat rose further in late 1973 and early 1974, export taxes and licenses were imposed to restrict EC wheat exports. EC grain prices in local EC currencies in-

[1] For more information on these trends, see Arthur B. Mackie, "International Dimensions of Agricultural Prices," *Southern Journal of Agricultural Economics*, Vol. VI, No. 1, July 1974.

[2] D. G. Johnson, "Are High Farm Prices Here to Stay?," *Morgan Guaranty Survey*, Aug. 1974.

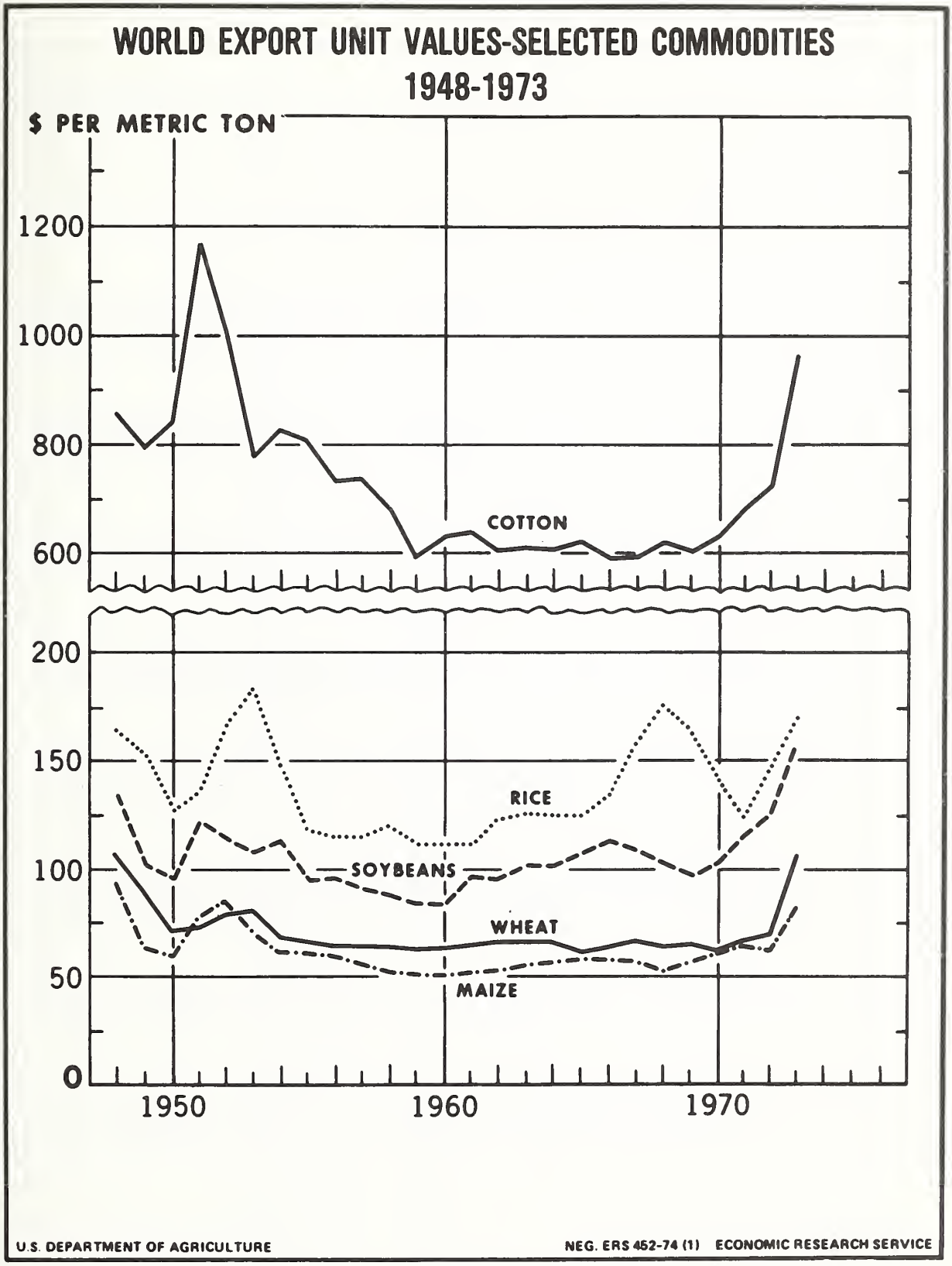
WORLD EXPORT UNIT VALUES-SELECTED COMMODITIES
1948-1973
$ PER METRIC TON
1200
1000
800
600
200
150
100
50
0
COTTON
RICE
SOYBEANS
WHEAT
MAIZE
1950
1960
1970
U.S. DEPARTMENT OF AGRICULTURE
NEG. ERS 452-74 (1) ECONOMIC RESEARCH SERVICE

Figure 9

Table 13—Average annual prices received by U.S. farmers for major commodities

Year	Wheat	Corn	Hay	Rice	Cotton	Soybeans	Peanuts	Beef	Poultry	Sugarbeets
	$/bu.	*$/bu.*	*$/ton*	*$/100 lb.*	*¢/lb.*	*$/bu.*	*$/100 lb.*	*$/100 lb.*	*$/lb.*	*$/ton*
1929	1.03	.76	14.12	2.22	16.78	1.86	3.73	9.47	--	7.08
1930	.66	.55	14.20	1.74	9.46	1.34	3.51	7.71	--	7.14
1931	.38	.29	11.44	1.08	5.66	.49	1.62	5.53	--	5.94
1932	.38	.29	8.71	.93	6.52	.53	1.55	4.25	--	5.26
1933	.74	.49	9.63	1.73	10.17	.92	2.85	3.75	--	5.36
1934	.83	.80	15.09	1.76	12.36	.96	3.28	4.13	.19	7.76
1935	.82	.63	10.66	1.60	11.09	.71	3.14	6.04	.20	6.96
1936	1.02	1.03	12.83	1.85	12.36	1.25	3.72	5.82	.21	6.05
1937	.96	.49	11.70	1.46	8.41	.84	3.30	7.00	.21	7.23
1938	.55	.47	9.10	1.42	8.60	.66	3.27	6.54	.19	6.55
1939	.68	.54	9.63	1.62	9.09	.80	3.40	7.14	.17	6.76
1940	.67	.60	9.78	1.80	9.89	.90	3.33	7.56	.17	7.00
1941	.93	.74	11.45	3.01	17.03	1.55	4.67	8.82	.18	8.30
1942	1.09	.89	13.30	3.61	19.05	1.60	6.09	10.70	.23	9.34
1943	1.35	1.08	17.72	3.96	19.90	1.81	7.12	11.90	.29	11.54
1944	1.41	1.03	20.12	3.93	20.73	2.05	8.05	10.80	.29	13.37
1945	1.49	1.23	19.45	3.98	22.52	2.08	8.27	12.10	.30	12.82
1946	1.90	1.53	20.64	5.00	32.46	2.57	9.10	14.50	.33	13.65
1947	2.29	2.16	22.13	5.97	31.93	3.33	10.10	18.40	.32	14.44
1948	1.98	1.28	23.55	4.88	30.38	2.27	10.50	22.20	.36	12.94
1949	1.88	1.24	21.38	4.10	28.58	2.16	10.40	19.80	.28	13.41
1950	2.00	1.52	21.56	5.09	40.07	2.47	10.90	23.30	.27	13.70
1951	2.11	1.66	23.05	4.82	37.88	2.73	10.40	38.70	.29	14.13
1952	2.09	1.52	24.52	5.87	34.59	2.72	10.90	24.30	.29	14.48
1953	2.04	1.48	22.07	5.19	32.25	2.72	11.10	16.30	.27	13.91
1954	2.12	1.43	22.18	4.57	33.61	2.46	12.20	16.00	.23	13.22
1955	1.98	1.35	20.98	4.69	32.33	2.22	11.70	15.60	.25	13.51
1956	1.97	1.29	21.30	4.86	31.75	2.18	11.20	14.90	.20	14.32
1957	1.93	1.11	18.62	5.11	29.65	2.07	10.40	17.20	.19	13.58
1958	1.75	1.12	18.16	4.68	33.23	2.00	10.60	21.90	.19	14.09
1959	1.76	1.05	20.62	4.59	31.66	1.96	9.56	22.60	.16	13.54
1960	1.74	1.00	20.41	4.55	30.19	2.13	10.00	20.40	.17	13.97
1961	1.83	1.10	20.42	5.14	32.92	2.28	10.90	20.20	.14	13.54
1962	2.04	1.12	21.18	5.04	31.90	2.34	11.00	21.30	.15	15.24
1963	1.85	1.11	21.44	5.01	32.23	2.51	11.20	19.90	.15	14.34
1964	1.37	1.17	23.48	4.90	29.76	2.62	11.20	18.00	.14	14.04
1965	1.35	1.16	23.42	4.93	28.14	2.54	11.40	19.90	.15	14.21
1966	1.63	1.24	24.11	4.95	20.84	2.75	11.30	22.20	.15	15.10
1967	1.39	1.03	23.04	4.97	25.59	2.49	11.40	22.30	.13	15.88

continued

Table 13–Average annual prices received by U.S. farmers for major commodities–continued

Year	Wheat	Corn	Hay	Rice	Cotton	Soybeans	Peanuts	Beef	Poultry	Sugarbeets
	$/bu.	*$/bu.*	*$/ton*	*$/100 lb.*	*¢/lb.*	*$/bu.*	*$/100 lb.*	*$/100 lb.*	*$/lb.*	*$/ton*
1968	1.24	1.08	22.75	5.00	22.15	2.43	11.90	23.40	.14	15.91
1969	1.25	1.16	23.57	4.95	21.09	2.35	12.30	26.20	.15	14.96
1970	1.33	1.33	24.20	5.17	21.98	2.85	12.80	27.10	.14	17.06
1971	1.34	1.08	26.28	5.34	27.10	3.03	13.60	29.00	.14	17.47
1972	1.76	1.57	31.93	6.73	26.21	4.37	14.50	33.50	.14	18.12
1973	4.00	2.38	42.84	13.80	43.10	5.57	16.20	42.80	.24	25.12

Wheat: season average price. **Corn:** season average price. **Hay:** simple average price. **Rice:** season average price. **Cotton:** season average price received by farmers, gross weight basis. Net-weight prices for 1971-73 divided by 1.04167 to convert to gross weight basis. **Soybeans:** season average price. **Peanuts:** season average price. **Beef:** season average price. **Poultry:** chickens, commercial broiler price. **Sugarbeets:** $/ton produced–total price including sugar act payment.

Source: *Agricultural Prices,* Statistical Reporting Service, USDA.

Table 14–Average annual real prices received by U. S. farmers for major commodities in 1970 dollars

Year	Wheat	Corn	Hay	Rice	Cotton	Soybeans	Peanuts	Beef	Poultry	Sugarbeets
	$/bu.	*$/bu.*	*$/ton*	*$/100 lb.*	*¢/lb.*	*$/bu.*	*$/100 lb.*	*$/100 lb.*	*$/lb.*	*$/ton*
1929	2.34	1.72	32.02	5.03	38.0	4.22	8.46	21.47	--	16.05
1930	1.53	1.28	33.02	4.05	22.0	3.12	8.16	17.93	--	16.60
1931	.97	.74	29.18	2.76	14.4	1.25	4.13	14.11	--	15.15
1932	1.08	.82	24.74	2.64	18.5	1.51	4.40	12.07	--	14.94
1933	2.22	1.47	28.83	5.18	30.4	2.75	8.53	11.23	--	16.05
1934	2.41	2.32	43.75	5.10	35.8	2.78	9.51	11.97	.55	22.49
1935	2.32	1.78	30.20	4.53	31.4	2.01	8.90	17.11	.57	19.72
1936	2.86	2.89	35.94	5.18	34.6	3.50	10.42	16.30	.59	16.95
1937	2.59	1.32	31.62	3.95	22.7	2.27	8.92	18.92	.57	19.54
1938	1.52	1.29	25.07	3.91	23.7	1.82	9.01	18.02	.52	18.04
1939	1.90	1.51	26.90	4.53	25.4	2.23	9.50	19.94	.47	18.88
1940	1.86	1.66	27.09	4.99	27.4	2.49	9.22	20.94	.47	19.39
1941	2.45	1.95	30.21	7.94	44.9	4.09	12.32	23.27	.47	21.90
1942	2.60	2.12	31.67	8.60	45.4	3.81	14.50	25.48	.55	22.24
1943	3.03	2.43	39.82	8.90	44.7	4.09	16.00	26.74	.65	25.93
1944	3.11	2.27	44.42	8.68	45.8	4.53	17.77	23.84	.64	29.41
1945	3.22	2.66	42.01	8.60	48.6	4.49	17.86	26.13	.65	27.69
1946	3.78	3.04	41.03	9.94	64.5	5.11	18.09	28.83	.66	27.14
1947	3.98	3.76	38.49	10.38	55.5	5.79	17.57	32.00	.56	25.11
1948	3.19	2.06	37.98	7.87	49.0	3.66	16.94	35.81	.58	20.87

continued

Table 14–Average annual real prices received by U.S. farmers for major commodities in 1970 dollars–cont.

Year	Wheat	Corn	Hay	Rice	Cotton	Soybeans	Peanuts	Beef	Poultry	Sugarbeets
	$/bu.	*$/bu.*	*$/ton*	*$/100 lb.*	*¢/lb.*	*$/bu.*	*$/100 lb.*	*$/100 lb.*	*$/lb.*	*$/ton*
1949	3.06	2.02	34.82	6.68	46.5	3.52	17.10	32.25	.46	21.84
1950	3.23	2.45	34.77	8.21	64.6	3.98	17.58	37.48	.44	22.10
1951	3.15	2.48	34.40	7.20	56.6	4.08	15.55	42.90	.43	21.12
1952	3.06	2.22	35.80	8.58	50.6	3.98	15.94	35.53	.42	21.17
1953	2.97	2.15	32.10	7.54	46.8	3.95	16.13	23.69	.39	20.22
1954	3.06	2.07	32.00	6.60	48.6	3.55	17.63	23.12	.33	19.10
1955	2.87	1.96	30.40	6.81	46.9	3.22	16.98	22.64	.36	19.61
1956	2.81	1.84	30.40	6.94	45.4	3.11	16.00	21.29	.29	20.46
1957	2.67	1.53	25.70	7.06	40.9	2.86	14.36	23.76	.26	18.76
1958	2.35	1.51	24.40	6.29	44.6	2.69	14.25	29.44	.26	18.94
1959	2.34	1.40	27.46	6.11	42.2	2.61	12.73	30.09	.21	18.03
1960	2.28	1.31	26.70	5.97	39.6	2.80	13.12	26.77	.22	18.33
1961	2.37	1.43	26.40	6.67	42.8	2.96	14.14	26.20	.18	17.56
1962	2.62	1.44	27.20	6.47	40.9	3.00	14.12	27.34	.19	19.56
1963	2.34	1.41	27.20	6.35	40.9	3.18	14.20	25.22	.19	18.17
1964	1.71	1.46	29.40	6.13	37.2	3.28	14.02	22.53	.18	17.57
1965	1.66	1.43	28.80	6.06	34.6	3.12	14.02	24.48	.18	17.48
1966	1.95	1.48	28.80	5.92	24.9	3.29	13.52	26.56	.18	18.06
1967	1.62	1.20	26.80	5.78	29.8	2.90	13.26	25.93	.15	18.47
1968	1.38	1.21	25.40	5.58	24.7	2.71	13.28	26.12	.16	17.76
1969	1.32	1.23	24.90	5.24	22.3	2.49	13.03	27.76	.16	15.85
1970	1.33	1.33	24.20	5.17	22.0	2.85	12.80	27.10	.14	17.06
1971	1.28	1.04	25.20	5.12	26.0	2.91	13.04	27.80	.13	16.75
1972	1.63	1.46	29.60	6.25	25.1	4.06	13.46	31.10	.13	16.82
1973	3.50	2.08	37.40	12.06	41.3	4.87	14.16	37.41	.21	21.96

Wheat: season average price. **Corn:** season average price. **Hay:** simple average price. **Rice:** season average price. **Cotton:** season average price received by farmers, gross weight basis. Net-weight prices for 1971-73 divided by 1.04167 to convert to gross weight basis. **Soybeans:** season average price. **Peanuts:** season average price. **Beef:** season average price. **Poultry:** chickens, commercial broiler price. **Sugarbeets:** $/ton produced–total price including sugar act payments.

Source: Table 13 deflated by Bureau of Labor Statistics Consumer Price Index, 1970=100.

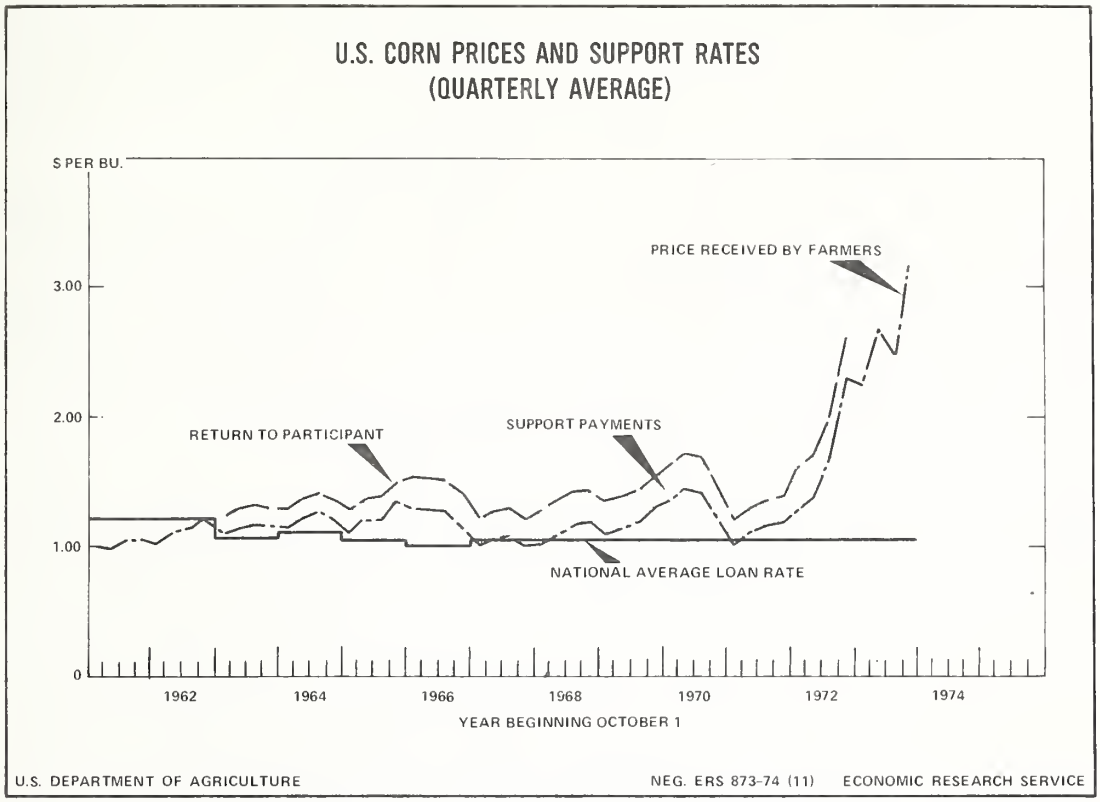

Figure 10

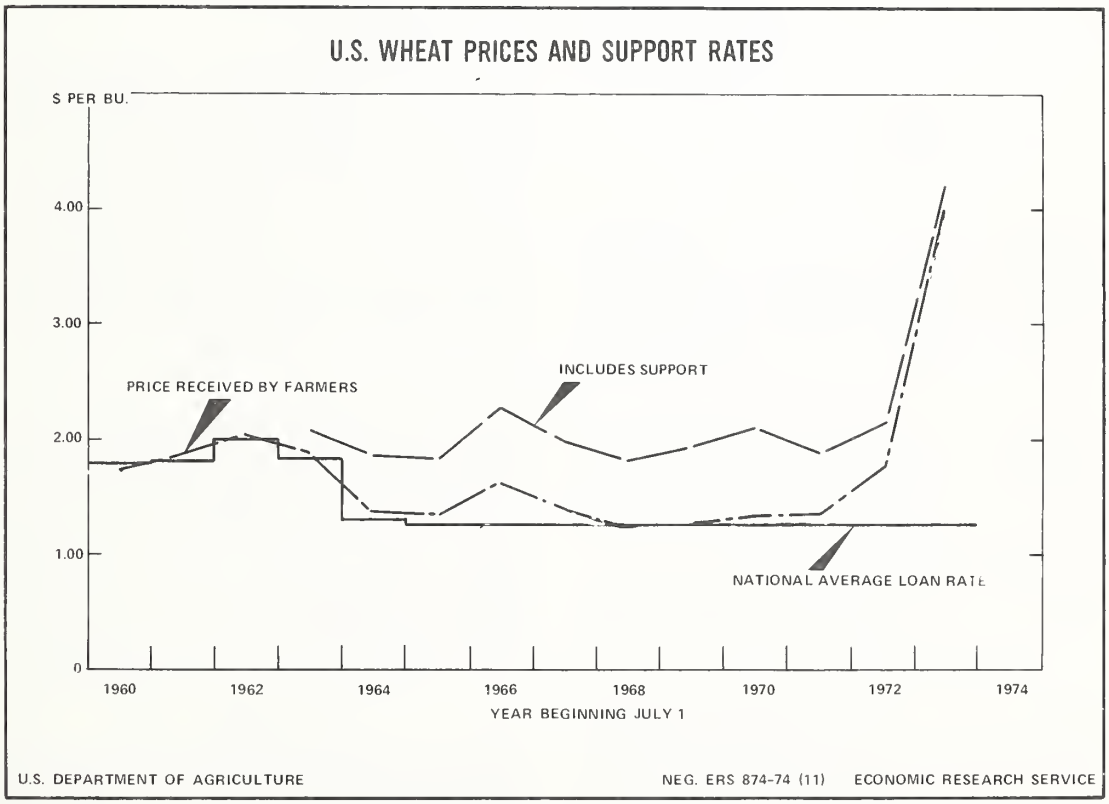

Figure 11

creased only about 10 percent between 1971 and 1974 (except in Italy) while the world price tripled.

USSR

Prices in the centrally planned economies are not necessarily determined by supply and demand, or even by production costs. The grain imports by the USSR in 1972 and 1973 were an important destabilizing force in the world food situation, but producers and consumers in that country have experienced little of the price impacts felt elsewhere around the world. In part, this was facilitated by the very low prices the USSR paid for its large 1972-73 wheat imports.

The prices received by state and collective farms in the USSR have not increased since 1970. Retail prices for meat and bread in state retail stores have not been changed since mid-1962 and did not change as a result of developments in 1972-74. In addition, while many food prices are higher in the USSR than in Europe or North America, the prices of bread and beef are lower.[3]

The Soviet Government follows a policy of providing low-priced bread for all consumers. For meat and dairy products, the Government absorbs a large deficit in order to keep consumer prices of these products unchanged while at the same time attempting to increase production. The cost of this subsidy rose from 6.5 billion rubles in 1969 to 12.6 billion rubles in 1974.[4]

Developing Countries

The level of food and farm prices in many developing countries is difficult to measure, and few statistics are available. In some countries, much of the food is produced and consumed by farm families in remote areas with little direct contact with outside markets. Prices in urban markets are often kept low by government policies.

Several kinds of policies which are practiced, although in different degrees, in a number of developing countries have important influences on how much food is produced in these countries and how much is consumed and traded internationally.

In countries where agricultural or food exports are one of the few sources of government revenue, these exports are sometimes taxed or internal prices manipulated in such a way that prices received by farmers are below what they would be without the tax. This is the case for rice in Thailand, rice and cotton in Egypt, grains and meat in Argentina, and peanuts and certain other crops in Africa.

Monetary and trade policies also lower prices to farmers in a number of developing countries. Persistent and sizable overvaluations of their foreign exchange rates artificially lower the prices received by farmers for agricultural exports and make imported food artificially cheaper. Embargoes and quotas are also used to channel agricultural output to the domestic market, thus lowering internal farm prices. Brazil has used such policies to implement its attempts to industrialize.[5]

Governments in many developing countries consider a low and stable retail price for basic foods—often cereals—to be an important objective of government policy. To meet this objective, prices of these commodities are controlled in various ways. Such policies are followed in Thailand, Egypt, Indonesia, and Sri Lanka, for example. These policies exist because most consumers have low incomes, spend much of their incomes on food, and much of their food expenditures go for cereals. The cost of basic cereals is thus important to the welfare of consumers. Food prices are also an important part of the cost of labor. It is feared that if the cost of food were to rise or fluctuate greatly, this would require increases or fluctuations in wages which would be disruptive to economic development in general.

While these policy goals are understandable with respect to consumers and to wageworkers in industry, their impact on the food production capacity and import pattern of the developing countries needs to be carefully evaluated. One of the most serious hurdles to be overcome in solving the food problems of the developing countries is the low level of rice yields in Asian developing countries. However, there is a close correlation between low rice yields and low rice prices and high prices of fertilizer relative to the price of rice (table 15).

While the price of fertilizer differs from country to country, the greater difference is in the price received by farmers for their rice. Among the lowest rice prices in the world are those received by farmers in Thailand and Burma, whose rice exports have stagnated in the past decade. An equally low price is received by Indonesian farmers. Each of these three countries, in different ways, regulates the domestic price of rice: Thailand and Burma hold down the prices their farmers receive for rice by export controls and export taxes. Indonesia imports rice and distributes it to keep rice

[3] Prices in collective markets are higher than in retail stores and did increase substantially during 1965-70, but very little bread and grain is sold in these markets. Meat prices, although fluctuating, apparently were not significantly different in June 1974 from the year-earlier level.

[4] The official value of the ruble in 1969 was $1.11 and in 1971, $1.20. The real value is much less.

[5] Schuh, G. Edward, "Effects of Some General Economic Development Policies on Agricultural Development," *American Journal of Agricultural Economics*, Vol. 50, No. 5, Dec. 1968, pp. 1283-1293.

Table 15—Comparison of rice and fertilizer prices and rice yields

Country	Paddy price to producers	Price of fertilizer nutrients to producers	Ratio of paddy prices to fertilizer prices	Paddy yield in 1970
	U.S. cents per kg.			*metric tons per ha.*
Japan	30.7	21.5	1.43	5.64
South Korea	18.4	19.1	0.96	4.55
Taiwan	11.7	26.2	0.45	4.16
Malaysia	8.8	20.3	0.44	2.72
Ceylon	11.3	15.8	0.72	2.64
Indonesia	4.5	15.2	0.30	2.14
Thailand	4.5	14.3	0.32	1.97
Philippines	7.0	17.3	0.41	1.72
Burma	3.1	25.1	0.12	1.70

Source: Falcon and Timmer, *The Political Economy of Rice Production and Trade in Asia*, Food Research Institute, Stanford, 1973.

prices low. All three countries appear to have considerable potential for expanding output of rice. but the low prices farmers receive are a serious hinderance. The rice exporting developing countries, however, face a limited export market in normal conditions (ch. 8), partly because Japan maintains self-sufficiency through high prices to its farmers, the European Community protects its producers of rice by high internal prices, import barriers, and export subsidies, and the United States exports rice through a combination of price supports and export subsidies.

The price Egyptian farmers receive for rice, a major export, is controlled by the Government and has averaged between 6.2 and 6.9 cents per kilogram (paddy) —close to the price received by farmers in the Philippines. As table 15 demonstrates, this price—while higher than prices received by Burmese, Thai, and Indonesian farmers—is far below that received by many other of the world's rice farmers. One of the reasons Egypt has been able to maintain this low price for rice is that it has been importing progressively larger quantities of wheat (from just over 1 million tons in 1960 to over 3 million tons in 1973), with larger imports expected in the future. Prior to 1967, these imports were obtained chiefly through concessional aid programs which permitted the Government to maintain a relatively low price for wheat.

Price Adjustments

Thus, while international food prices were relatively stable during the two decades prior to 1972, domestic farm prices in the developed countries were generally above international price levels, and those of many developing countries were below these levels. This phenomenon cannot be disassociated from the problems of surplus food production in the developed countries and growing food deficits in the developing and centrally planned countries—generally recognized as the key problem needing solution if the world food situation is to improve.

It will obviously not be a simple matter to relax the longstanding domestic price policies of the developing, developed, and planned economies. The supported prices of the developed countries have grown out of a long history of political accommodation to domestic farm and consumer interests. Those of the planned economies have been central to their developmental philosophy. For the developing countries, the problem is especially difficult since the implication is that basic food prices would have to rise somewhat above the levels of the past. But the rise in food prices implied for the developing countries would be relatively small, and prices would be considerably lower than at present. Since more than half the population of most of these countries is made up of farmers, the improvement in incomes would be widely distributed.

Regardless of the difficulty involved in a worldwide readjustment of prices, the persistent and expanding imbalance in food production among and within the three different kinds of economies must be corrected, and the above analysis indicates that part of the correction must involve price adjustments.

4. PROJECTED WORLD FOOD SUPPLY AND DEMAND

The FAO and the Economic Research Service of USDA both regularly analyze agricultural developments and project their implications for the long-term world food situation. Work has generally been done on a country and commodity basis, as well as a world supply, demand, and trade basis.

With less regularity, other organizations and individuals make special studies of world food prospects. Such a study by Iowa State University (ISU) has received wide circulation and is representative of these analyses.

This chapter presents the latest set of USDA projections that have a direct bearing on the world food situation. First, however, it compares the assumptions, methods, and results of the FAO, ISU, and ERS projection studies. Special attention is paid to the food situation in the developing countries, particularly to the growing food deficits that these studies all suggest may continue unless appropriate action is taken to change this developing trend.

Comparison of Earlier Projection Studies

FAO's most recent detailed study, *Agricultural Commodity Projections 1970-1980,* was published in 1971. It projects an improvement in world agricultural production during the decade of the 1970's, but with limited per capita improvement in the developing countries. FAO's projections emphasize nutrition and conclude that significant calorie shortages will persist in 1980. The FAO projections were modified by developing broad regional projections to evaluate prospects for 1985 in the *Assessment of the World Food Situation, Present and Future,* which was prepared for the November 1974 U.N. World Food Conference in Rome. In the following comparisons of the FAO, ISU, and USDA projections, the FAO projections to 1985 are used.

The Iowa State University report, *World Food Production, Demand, and Trade,* includes projections to 1985 and 2000. The analysis incorporates the results of a number of studies of land availability in developing countries in its projections of area (ch. 8). The ISU report provides a synthesis of regional production-demand comparisons. It excludes full consideration of the impact of the Green Revolution because it uses the early 1960's as a base period. However, technological improvements and alternative government policies, as well as their effect on future production levels, are discussed in the study.

USDA projection studies have concentrated on major commodities. Grain has been used as an indicator of future food supplies and needs. World commodity projections to 1980 were published in 1970 and 1971. Since then, commodity projections have been extended to 1985, and results have been included in a number of papers and reports. These projections have concluded, as have those of FAO and ISU, that developing countries will experience increasing grain imports to 1985.

The earlier USDA projections to 1985 developed two alternatives. The first was based on a continuation of past trends and continued implementation of established policies (including, for example, enlargement of the European Community). The second alternative assumed a more rapid growth in world grain demand and trade because of increased use of grain for feed in the USSR, Eastern Europe, the EC, and the livestock economies of the developing countries.

The projections were based on analysis completed before the emergence of the world energy crisis. They recognize, however, that the late 1960's and early 1970's period was one of relatively low prices (in real terms) for both inputs and outputs in the cereals economy. Low energy costs gave the United States a competitive advantage in cereals production since it uses an advanced energy-intensive technology. These USDA projections assumed continuation of relatively low energy input costs. Under the alternative that assumed a high world import demand, the projections suggested that the United States would have captured most of the growth in the world import market, partly because of reserve capacity, and partly because of its low-cost energy inputs.

Scope of Projection Studies

Commodity Coverage

FAO's projections are made for the bulk of the world's agricultural products, including forest and fishery products. Separate demand projections are made for 60 commodities, and production projections are made for 40 commodities.

In the ISU study, 73 crops and agricultural commodities are represented, although the maximum reported in any individual country analysis is 41. Projections were made for nine food categories—cereals, raw sugar, root crops, pulses, fruit and vegetables, oil crops, meat, milk, and eggs.

The USDA commodity projections have concentrated on cereals, oilseeds, and livestock products, although some additional crops, such as cotton, have been included. Within the cereals-oilseeds-livestock sector, the commodities included are wheat, rice, coarse grains, oilseeds, beef, pork, poultry, mutton and lamb, milk, butter, cheese, and eggs. The commodity projections take into account the interrelationships within the cereals-oilseeds-livestock sector.

Country Coverage

In the FAO projections, 132 countries, accounting for 99.6 percent of world population, are covered individually. These are grouped according to official U.N. categories of Economic Class I (developed market economies), Economic Class II (developing countries), and Economic Class III (centrally planned countries). Frequently, FAO reclassifies these into high-income countries (Class I plus USSR and Eastern Europe), developing countries (Class II), and Asian centrally planned (People's Republic of China, North Korea, Mongolia, and North Vietnam).

The ISU projections include 96 countries but exclude the People's Republic of China. Countries are grouped primarily on a regional basis, and projections are presented on a regional basis.

USDA's projections have concentrated on major countries and major regions of the world rather than on a summation of individual countries. These regions and countries sum to a world total. The number of regions considered varies from commodity to commodity, depending on the importance of the regions in world trade in that commodity (28 for cereals).

Assumptions of Projection Studies

Population

In its projections, FAO uses one population assumption, the U.N. medium projection as assessed in 1968 and updated for some 60 countries as of early 1971. The population assumption represents the continuation of trends at the world level with a small acceleration in the developing countries. The FAO *Assessment* uses the 1974 U.N. population data.

The ISU analysis derived its population projections from U.N. estimates made in 1963. Three alternative population projections—low, medium, and high—are presented.

USDA projections are based, in general, on the U.N.'s 1974 medium growth population variant, except for the United States, for which the U.S. series E is used.

Income

For high-income countries, the FAO study uses one growth rate of GNP and associated private consumption expenditure (PCE), which are from OECD and EC projections as assessed in 1970. For developing countries, FAO uses two alternative growth rates: (a) a "trend" alternative which reflects some acceleration in past trends and (b) a "high" alternative based on targeted growth rates established for the Second Development Decade. The "trend" alternative assumes a 3.0-percent growth rate, compared with a 2.1-percent rate during the 1960's, the "high" alternative reflects the probable maximum growth foreseeable to 1980.

ISU also used extrapolations from past trends in income growth for all but 12 developing countries. For the 12 countries, trends in income growth were based on data from similar nearby countries. Personal consumption expenditure was used and, if not available, other income variables such as national income, GDP, net material product, or net domestic product were used.

USDA's projections use per capita private consumption expenditure estimates or, if PCE data were not available, GDP and net material product as demand indicators. ERS has used the latest OECD, EC, and FAO income projections available at the time of analysis. The projections presented in this report under alternative I use the projected "trend" income values from FAO's *Assessment*. The low demand alternative III assumes income growth rates to be one-third lower in all areas, assuming that the current inflation and economic stagnation will have this impact on growth rates. For the developing countries, this corresponds roughly to the growth rate experienced during the 1960's. The high demand alternatives II and IV assume more rapid income growth rates.

Prices

Demand and production in the FAO and ISU reports are projected assuming constant base period prices.

The USDA projections discussed below project demand, production, and trade simultaneously with major commodity prices. Prices in each projection set are different, depending on the supply and demand conditions assumed. These prices are in real terms (constant 1970 purchasing power). Because of relative stability in grain prices, previous USDA projections carried prices in nominal terms and allowed for price inflation in the United States and the rest of the world.

Exchange Rates

In the USDA projections, prices for several major countries are expressed in real local currencies (1970 exchange rate values). It is assumed that changes in exchange rates between countries reflect mainly the difference in inflation rates between countries.

Policy Frameworks

FAO assumes that national agricultural policies in operation in 1970 or early 1971 would remain the same over the projection period. For example, their projections do not take into account the enlargement of the EC through the accession of Denmark, the United Kingdom, and Ireland, and the effect of this on production. The ISU projections also assume a continuation of present policies throughout the projection period.

USDA projections also assume that present policies will continue throughout the period to 1985. They assume that major exporters will adjust production rather than permit either the continuation of present unusually high price levels or the appearance of sizable surpluses.

Technology

FAO projections assume that technology will continue to evolve as in the recent past. Since the base period for the ISU study does not extend into the mid-1960's, its projections reflect a lower level of technology than either the USDA or FAO studies, particularly for areas of South and Southeast Asia affected by the Green Revolution.

USDA's projections assume that the developed countries will continue to take advantage of the latest technological innovations and that limitations on the rate of adoption will primarily be the relative cost of inputs. An analysis has been made of the response of grain production to increased inputs. A basic trend growth in inputs is projected under alternatives I-III, which is modified depending on the product prices. Under alternative IV, the level of the resource bundle (fertilizer, irrigation, and capital) is increased for the developing countries to assess the effect of changing technology on output.

Comparison of Projection Results

ISU

The ISU study projects huge grain surpluses in developed countries and a large deficit in developing countries (tables 16 and 17). The study does not reflect much of the technological advance associated with the Green Revolution, by virtue of an early base period. There is considerable expansion in area cultivated during the base period, but irrigation and other investments are limited.

The constant base prices assumed in the ISU projections are not high enough to provide much incentive for developing country farmers to increase production. Large concessionary grain deliveries to developing countries, together with tariff and other measures to support developed country prices, were assumed. Thus, high farm prices are projected to exist in developed countries, and this causes the accumulation of an unmanageable grain surplus of 171 million tons.

Meanwhile, deficits of 114 million to 118 million tons of grain are projected for developing countries.

FAO

The FAO commodity projections are for a later base period than are the ISU projections. They thus reflect more recent trends that include the effects of the first years of the Green Revolution. The FAO projections contained in the *Assessment* inject some of the current food crisis constraints, including the bad weather and poor crop yields of 1972, the incipient fertilizer shortage, and the energy crisis—but not high product prices.

The FAO projections stress the growing dilemma of grain surpluses in developed countries and rising deficits in many developing countries, particularly South and Southeast Asia. The most recent FAO projections in the *Assessment* specifically take into account the development of the current crisis. A net deficit of 85 million tons of grain is projected for the developing market economies by 1985, due in part to both a larger population and a higher rate of economic growth (more people eating more food per person). The deficit increases to 100 million tons if the major developing country exporters are excluded.

Table 16–Comparison of cereal projections to 1985[1]

Item	FAO base (1969-71)	FAO 1985	USDA base (1969-71)	USDA-I 1985	USDA-II 1985	USDA-III 1985	USDA-IV 1985	ISU 1985
				million metric tons				
World								
Demand	1,207	1,725	1,062.6	1,548.5	1,618.7	1,501.8	1,643.9	1,145.5
Production	1,239	NS	1,081.8	1,550.4	1,620.6	1,503.6	1,645.7	1,187.3 (L)
Balance[2]	+32	NS	19.2	1.9	1.9	1.9	1.9	1,191.7 (H)
								41.8 (L)
Developing countries								46.2 (H)
Demand	590	929	466.6	691.2	726.2	678.6	743.5	
Production	585	853	443.1	632.4	648.7	626.2	721.0	
Balance	-5	-76	-23.5	-58.8	-77.5	-52.4	-22.5	
Developing market economies								
Demand	386	629	299.7	479.4	512.6	466.7	529.1	524.7
Production	370	544	279.2	424.7	441.0	418.7	513.3	411.0 (H)
Balance	-16	-85	-20.5	-54.7	-71.6	-48.0	-15.8	406.6 (L)
								-113.7 (H)
Asian centrally planned countries[3]								-118.1 (L)
Demand	204	300	166.9	211.8	213.6	211.9	214.4	
Production	215	309	163.9	207.7	207.7	207.7	207.7	
Balance	+11	+9	-3.0	-4.1	-5.9	-4.2	-6.7	
Developed countries[4]								
Demand	617	796	596.0	857.3	892.5	823.2	900.4	403.4
Production	654	NS	638.7	918.0	971.9	877.4	924.7	574.0
Balance	+37	NS	42.7	60.7	79.4	54.2	24.3	170.6

[1]The data for FAO and USDA are not comparable because FAO carries rice as paddy, USDA carries rice as milled. [2]Imbalances for USDA between demand and production in base are due to stock buildup, timing of shipments, and missing data on a number of small importers. Projected equilibrium does not allow for building or reducing stocks. [3]FAO Asian centrally planned includes the People's Republic of China and other Asian centrally planned countries (North Korea, North Vietnam, etc.), while USDA includes only the People's Republic of China. [4]Includes the USSR and Eastern Europe.

Note: Detail may not sum to total because of rounding.

NS = not shown.

Table 17—Comparison of rates of growth of production and demand for cereals from 1969-71 to 1985[1]

Item	Total					Per capita				
	FAO	USDA-I	USDA-II	USDA-III	USDA-IV	FAO	USDA-I	USDA-II	USDA-III	USDA-IV
	percent									
World										
Demand	2.4	2.5	2.8	2.3	3.0	.4	.6	.9	.4	1.0
Production	NS	2.4	2.7	2.2	2.8	NS	.5	.7	.2	.9
Developing countries										
Demand	3.1	2.7	3.0	2.5	3.1	.7	.3	.6	.1	.8
Production	2.5	2.4	2.6	2.3	3.3	.2	.02	.2	-.05	.9
Developing market economies										
Demand	3.3	3.2	3.6	3.0	3.9	.6	.5	.9	.3	1.1
Production	2.6	2.8	3.1	2.7	4.1	-.1	.1	.4	.02	1.4
Asian centrally planned countries[2]										
Demand	2.6	1.6	1.7	1.6	1.7	1.0	.05	.1	.05	.1
Production	2.4	1.6	1.6	1.6	1.6	.8	.03	.03	.03	.03
Developed countries[3]										
Demand	1.7	2.4	2.7	2.2	2.8	.8	1.5	1.8	1.3	1.9
Production	NS	2.4	2.8	2.1	2.5	NS	1.5	1.9	1.2	1.6

[1] Based on data in table 16. [2] FAO Asian centrally planned includes the People's Republic of China and other Asian centrally planned countries (North Korea, North Vietnam, etc.), while USDA includes only the People's Republic of China. [3] Includes the USSR and Eastern Europe.

USDA Projections

This section presents four alternative projections for wheat, coarse grains, and rice.[1] The population and income assumptions have been discussed above. The projections integrate the supply and demand estimates into a single framework allowing for their simultaneous projection.

Alternative I assumes that economic growth has been temporarily slowed, but resumes strong expansion in the late 1970's and early 1980's. However, under this alternative, continued high internal prices limit expansion of world trade.

Alternative II is a high world import demand situation. Under this alternative, income grows at a faster rate in both the developing and developed countries than under alternative I. In addition, there is progress toward removing barriers to trade in the developed world, and the centrally planned economies increase their efforts to improve diets.

Alternative III is a low demand situation that assumes economic stagnation would continue in the late 1970's and recovery does not occur until the 1980's.

Alternative IV reduces the developing countries' import needs by assuming that they increase their investments in food production by embarking on a policy of increasing the bundle of inputs used to produce food.

The USDA projections published in this report confirm some of the results obtained from USDA analyses made prior to the current energy crisis. They indicate that productive capacity in world grain production over the next decade will permit continued improvement in per capita consumption of food in the developing world. Under alternative I, per capita cereal consumption is expected to increase from 187 kilograms in 1970 to 195 kilograms in 1985. The per capita increases in projected consumption under all alternatives assume the availability of either sufficient foreign exchange to finance the rise in imports generated by the higher income levels or the access to concessional supplies.

These analyses assume higher input (fertilizer, oil, etc.) prices, and project higher product (grain) prices. Previous USDA projections to 1985 assumed a continuation of the low input costs of the 1970 base; thus, grain prices (in real terms) were expected to continue the historical decline of the last two decades. In the projections published here, however, higher input costs would be expected to arrest the downturn in grain prices (in real terms) except under the low world import alternatives. Grain prices (in real terms) are expected to be somewhat above the lows of the 1970 base but below the current high levels. Even in the high demand situation, they would be below today's level.

These projections also tend to confirm some of the earlier results with respect to the world meat economy. Contrary to the trends in the last two decades, real prices of meat are expected to show only modest rises relative to real grain prices. The higher input costs of grain for feed could slow the rate of expansion of meat production and trade, as compared with conditions assumed in the earlier analyses, unless mitigated by efficiencies in production and marketing of meat.

Long-term growth in world food and feed grain demand is projected under all alternatives considered. Consumption of wheat and rice would grow less rapidly than that of coarse grains because of faster growth in feed demand generated by expanding livestock and poultry production. The analysis also suggests that the developed and centrally planned countries—grain importing as well as grain exporting countries—will continue to supply the developing importing countries with grain, and the developed importing countries will increase their feed grain imports. Very little growth in total demand for wheat is expected in the developed countries. However, per capita demand for wheat in Japan will continue to grow as wheat is substituted for rice. Demand for wheat in the European Community will also continue to grow as more wheat is fed. Rice demand is expected to increase but not fast enough to become an important factor in the Western diet. Thus, the big factor in the growth in demand for grain in the developed countries will be the continued growth in the livestock sector.

In contrast, substantial increases in demand for grains for direct food use are expected over the next decade in the developing market economies, primarily due to an expected 2.7 percent growth in population. Total cereal consumption is projected to rise at an annual rate of 3.2 percent under alternative I. Consumption of individual grains will depend more on production capabilities (technology) and import policies than on potential demand derived from income and population growth. In India, for example, growth in rice production is not expected to keep pace with

[1] The inputs to the projections to 1985 were growth rates for population and income, price and income elasticities for demand and supply, input variables, and assumptions about basic underlying economic trends and policy constraints. These inputs provided the basis for formal mathematical relations which, with the aid of a computer program, projected area, yield, production, use, trade, and prices. The coefficients for the mathematical relations were synthesized either from statistical analyses or judgment of experts. Normal weather (i.e., average conditions which cancel out both unusually poor or good years) is assumed. An attempt is made to take into account changes in preferences in consumption, such as increasing desire for livestock products as incomes rise; changes in resource constraints; and trends in yield growth which try to capture the effect so far of the Green Revolution. Unless otherwise specified, continuity in present policies guiding domestic production, consumption, and international trade is assumed.

the growth in potential demand for rice suggested by income and population growth.

Because wheat is cheaper to import in terms of food equivalent and because productivity in wheat is projected to exceed that of rice, the potential gap between rice production and consumption under all alternatives would be translated into increased consumption of wheat. Thus, the gap between grain production and consumption in the developing countries will be met mostly with wheat imports. In addition, the developing countries with limited foreign exchange resources are expected to give food grains priority over feed grains. However, those with abundant foreign exchange could import feed grains, particularly under the high demand alternative II.

The projections suggest that the nature of the food problems facing the world over the next decade will hinge on the extent to which the developing world builds up a grain-feed-livestock sector. If the developing countries continue on an essentially cereals diet, particularly under the low demand conditions assumed in alternatives I and III, and if the consumption of animal protein in developed countries rises only moderately, world grain exporters would have no serious problem meeting world import demand. The world is capable of producing enough grain at reasonable prices to meet the demands of a largely cereal diet in the developing world. Even if demand expands by a modest increase in feed use in the developing countries, as projected under alternative II, production should be sufficient to prevent excessive price increases.

The world grain balance also hinges on the extent to which the lower income countries of the developed world follow the feed usage patterns of the United States and the European Community. Consumption of livestock products in the lower income developed countries is low. If income grows rapidly in the developed countries and if this is translated rapidly into a demand for livestock products, grain prices could be pushed up. But substantial price rises could slow the growth in the use of grains for feed. Feed grain demand cannot be expected to increase substantially unless grains are reasonably priced relative to livestock products.

The extent of consumption growth in the developing countries will also depend on the transfer of technical progress and the improvement of production techniques. In the developed countries, grain production will continue to take advantage of capital-intensive technological innovations. Productivity increases in the developing countries will require less capital-intensive techniques to prevent unemployment, but higher energy costs should stimulate the development of such techniques and improve the competitive position of countries which use low-energy production methods.

Alternative I—This alternative projects moderate growth in world food and feed grain demand. Continued growth in world grain import demand is constrained by high internal prices and other policies of major importing countries to limit imports.

The assumptions of alternative I imply that the world's capacity for production of cereals could increase faster than consumption but that some effort is made to restrict production in the major exporting countries to prevent the building up of stocks.

Under this alternative, the enlarged EC would continue to limit imports through its variable levies, and Eastern Europe and the USSR would approach self-sufficiency in grains, even though they are currently substantial importers of feed grains. China would likely continue to import wheat and export rice. Japan would remain the largest single country importer of wheat and coarse grains.

Production in the developing countries would continue growing slightly faster than population. A generally favorable world supply situation would allow the developing countries to import enough grain from the developed world to improve per capita consumption. In this alternative, grain imports by the developing market economies in 1985 are projected to increase to 55 million tons, which compares with 20 million tons in 1970/71.[2]

Alternative II—The high demand alternative II projections, in attempting to anticipate what would happen should world demand grow more rapidly than suggested under alternative I, incorporates the following additional assumptions:

—Income growth rates increase by 20 percent in developed countries and by 40 percent in developing countries;

—The USSR and Eastern Europe attempt to increase livestock production and consumption at a faster rate, even if this means importing more grain and high overall levels of trade with the western countries;

—The People's Republic of China imports more grain;

—The enlarged EC finds it advantageous not to pursue as strongly a self-sufficiency policy by setting lower internal price targets, thus permitting a higher level of grain imports; and

[2] This assumes, however, that the developing countries would have the foreign exchange to purchase such quantities or that concessional arrangements could be made.

—The livestock economies—particularly those producing poultry—grow faster in developing countries with enhanced petroleum revenues and in those with high rates of economic growth.

The higher demand for livestock products under alternative II would generate a substantial increase in demand for coarse grains. Higher feed prices would encourage more feeding of wheat in the developed countries, particularly in Western Europe where wheat competes with barley for feed use.

If foreign exchange were available, grain imports by the developing market economies could increase to 72 million tons. With limited foreign exchange, this high level of imports could not be maintained without a substantial increase in concessional sales above levels of recent years. The world price of grains would be significantly higher under alternative II than under alternative I, but below the high price levels of 1974.

Alternative III—The rate of income growth is projected to be one-third lower than that assumed under alternative I. As expected, world demand for grain would be lower. Prices (in real terms) also would be lower. The sharpest drop in grain consumption would occur in feed use.

Per capita demand for grains in the developing countries would grow slowly and import demand would be 7 million tons below the alternative I level. Major exporters would have the production capacity to expand concessional sales because of loss of grain markets in the developed world.

Alternative IV—This alternative was incorporated in the projections to test the effect on developing country production of increasing the level of fertilizer use. Increased fertilizer use implies increases in a number of other inputs (irrigation, pesticides, insecticides, hybrid seed, etc.) on which only limited data are available. Fertilizer response coefficients were derived from farm management and experiment station data or estimated in view of a region's natural resources and level of technological development.

In all developing regions, usage (in physical terms) was increased 1 to 1½ percent per year above the 1960-72 trend growth assumed in alternatives I, II, and III. Increasing fertilizer use reduced potential grain imports of developing countries from 72 million tons under alternative II to 16 million tons under alternative IV, with most of the impact on wheat imports. Prices of wheat, which were about a fourth higher under alternative II than under alternative I, fall back and approach levels of feed grain prices.

This fundamentally different situation for the developing countries—a major reversal in the trend of their import deficits—would be produced by the additional use of 15 million tons of fertilizer and associated technology and inputs to make its use effective in the developing countries. While the cost of such an effort would be substantial and could not be borne by the developing countries alone, the analysis indicates that it is possible to reduce the "world food gap" significantly.

It is difficult to project the effect of improved grain technology in the developing countries because of the short history of the Green Revolution. The late 1960's and early 1970's were years of marked technological advance. More attention was given to purchased inputs, especially fertilizer. Both the area cultivated and the area irrigated expanded, with some increase in double-cropping in irrigated areas. The longer term effects of these 5 to 7 years of technological advances were disguised to some extent by generally poor weather, as well as by institutional and marketing constraints. The late 1960's and the beginning of the 1970's were also years of generally weak grain prices in the developing world, with the exception of a few countries which raised support prices to encourage the use of new varieties. Prices also turned downward in the foreign markets to which developing countries sold their grain.

Examples of the problem of projecting the effect of improved inputs are South Asia and Southeast Asia. Recent developments in South Asia suggest some slowdown in the progress of the Green Revolution as compared with earlier expectations. In Southeast Asia, military conflicts have disrupted rice production in South Vietnam, Cambodia, and Laos, while low prices and government procurement programs have discouraged production in Burma and Thailand. The USDA projections do not indicate much output improvement in Southeast Asia, but this could be changed with improved social and political conditions and different production policies.

Substantial increases in production in developing countries would require:

(a) Expanded government programs to provide the foreign exchange and farm credit necessary to increase the use of inputs;

(b) Research into development and adaptation of new varieties to adverse and diverse local situations;

(c) Investment, including new irrigation and improved water management;

(d) Institutional support for research, extension, and improved supply and distribution of inputs;

(e) Incentive prices.

5. WORLD FOOD SECURITY AND GRAIN STOCKS [1]

Recent events have shown that large amounts of grain can be quickly withdrawn from the world's grain reserves—carryover grain stocks have declined about 80 million tons from the peak level of the beginning of the 1969/70 marketing year. When grain reserve levels are low, grain prices fluctuate widely in response to changes in output. This causes other food prices to change as well, and when the change is a sharp price increase, it imposes a special hardship on the world's poorest consumers. The disappointing crops of 1974 have demonstrated that it is not always possible to rebuild stocks quickly, even with a major effort.

These conditions have caused a renewed interest in rebuilding grain stocks for the purposes of providing for world food security and for grain price and supply stability. The issues involved are complex. The extremely high food prices and uncertain food supplies which have prevailed over the past 2 years are not satisfactory. Nor were they intended or anticipated. They resulted partly from policies to reduce stocks (ch. 2) but also from a complex of other exceptional circumstances (ch. 1). Higher stock levels than those prevailing now are desired by almost everyone.

The large grain stocks of the past resulted from policies which induced surpluses in the countries which held them. These surpluses provided large amounts of food aid and permitted relative stability in world grain prices. But they were a burden on taxpayers in countries holding the stocks and led to policies to slow down the growth of grain production in developed countries after 1967. These surpluses also contributed indirectly to the developing countries' growing dependence on grain imports by permitting them to postpone needed agricultural development programs. Low grain prices and plentiful supplies also contributed to the reliance of the planned economies on imported grains in years of bad harvests (ch. 2). In the developed countries, low grain prices in the last half of the 1960's contributed to reduced food grain production and to more grain fed to livestock (ch. 3).

Some Questions About Stocks

It seems evident that grain reserves will be rebuilt when production levels permit. But how large these reserves should be, who should hold them, where they should be held, who should pay for them, and by whom and how they should be managed, are unresolved issues. A number of measures are related to, and affect, the needed quantities of reserves. These include: (1) production adjustments; (2) import/export management, including export monitoring and licensing, long-term contracts, and other controls; and (3) international sharing of information on demand, production, stocks, and import and export intentions.

FAO has presented a proposal for ensuring a minimum level of world food security against serious food shortages and for international action to assure adequate basic food stocks.[2] The proposal has four essential elements:

1. **Adoption of national stockholding policies** which would maintain a minimum level of basic food stocks for the world as a whole.

2. **Establishment of national stock targets,** aiming at stock levels necessary to ensure continuity of supplies to meet domestic and, where appropriate, export requirements in case of crop failure or natural disaster.

3. **An improved system of information** gathering and exchange of information on the world's food position so that appropriate action can be taken to safeguard world food security.

4. **Expansion and coordination of assistance to developing countries** so that they can participate more effectively in the system.

While the concern of FAO is world food security, other proposals for resumption of national grain reserves in the United States stress both this purpose

[1] The Economic Research Service plans to publish a more detailed study of this subject early in 1975.

[2] FAO, *World Food Security: Proposal of the Director General,* Aug. 1973.

and the need to restore stability to U.S. and world grain prices at the farm and consumer levels.[3] There is opposition, however, if not to grain reserves as such, to a resumption of grain reserves held by the U.S. Government.[4]

World food security can be looked at in both a short-run and a long-run sense. In the short-run, food stocks are the only dependable form of security. Long-run food security can only be assured by improving the ability of the world to feed itself (ch. 8). Grain reserves also are relevant to the issue of world food security. Their role is to smooth year-to-year fluctuations in grain production and to meet contingencies in the world. They can also be used for famine relief or for grain market stabilization or for both purposes. Food reserves to provide short-term emergency famine relief would involve relatively small amounts of grain, perhaps around 10 million tons. Such a reserve would be relatively inexpensive and would have limited influence on world prices. A grain reserve which provided greater amounts of protection against large fluctuations in grain supplies and prices would be more costly and would be subject to controversy over how it would be used and who would make decisions about its use. A level of world grain reserve stocks sufficient to cover most major contingencies would range from perhaps 56 million to 80 million tons, except in the case of a series of exceptional production shortfalls.

Because of the level of grain stocks involved, agreement among countries may be reached more easily on the need to provide emergency famine and disaster relief than on a grain reserve program that would help in stabilizing the world grain market. The question of how to support a famine-relief effort is, of course, debatable. One suggestion is that the cost might be borne by the developed country aid donors in proportion to their gross domestic product. If a famine-relief reserve of 10 million tons were allocated among the developed countries according to the relative size of their GDP, the amount the United States would have to provide would be about 3 million tons. The cost of this program would depend largely on how frequently it would be used, but the cost would be small.

How Much Grain to Cover Various Contingencies?

A number of recent studies have calculated the quantities of grain necessary to cover deviations from trend levels of production, consumption, yields, and trade to arrive at approximations of the stock levels that might be held to cover these contingencies.[5] The following discussion of production and import variations from trend draws upon a study underway in the Economic Research Service.[6]

Production and Import Variations

During 1960-73, world wheat production fell below trend in 7 years. The largest shortfalls from trend were 20 million tons in 1963, 13.5 million tons in 1965, and 10 million tons in 1972. The USSR was the major cause of these world shortfalls, registering declines from trend of 20, 16, and 12 million tons, respectively. Shortfalls from trend in the developing countries were much smaller; the largest was 4.5 million tons in 1966. Fluctuations in production in the developed countries were largely due to adjustments in area planted.

The largest declines in rice production below trend were in 1965, 1966, and 1972, and amounted to 7, 15, and 13 million tons, respectively. India experienced the largest of these shortfalls in all 3 years—7.5, 8, and 5 million tons.

Coarse grain production exhibits sizable year-to-year fluctuations, primarily in the developed countries. Production at the world level has been above trend as much as 32 million tons in one year (1960) and below trend by 20.7, 18.0, and 15.4 million tons in 1964, 1965, and 1970. During the 1960-73 period, the centrally planned countries experienced their maximum production shortfall from trend in 1965—11 million tons—but had four consecutive shortfalls totaling 20 million tons in the mid-1960's. Developing countries had consecutive production shortfalls during 1971-73 totaling 15 million tons; the maximum shortfall in one year was 6 million tons.

Deviations from trends in world grain imports are smaller than production deviations. The maximum above-trend deviation for world wheat imports was 10 million tons in 1972. The other two major above-trend deviations were in 1963 (7.8 million tons) and 1965 (8.0 million tons). These occurred in the centrally planned countries, primarily the USSR. Deviations

[3] W. Cochrane, *Feast or Famine: The Uncertain World of Food and Agriculture and its Policy Implications for the United States,* National Planning Association, Feb. 1974; S2005 and S2831, 93rd Congress, First Session.

[4] See the major dissenting opinions of Buck, Hamilton, Hoffman, Hoover, and Schultz to the National Planning Association proposal, and the statement of the American Farm Bureau and National Association of Wheat Growers, both of which are included in *Feast or Famine, ibid.*

[5] See, for example, Bailey, Kutish, and Rojko, *Grain Stock Issues and Alternatives,* Economic Research Service, USDA, Feb. 1974; and Committee on Commodity Problems, FAO, *World Food Security: Draft Evaluation of World Cereals Stock Situation,* July 1974.

[6] W. Scott Steele, "The Grain Reserve Issues," Economic Research Service, USDA, unpublished.

above trend in coarse grain and rice imports are much smaller. The amounts of grain needed to cover different degrees of the shortfall deviations from trend production and imports are indicated in tables 18 and 19.

Based on aggregate world production for 1960-73, and assuming no trade barriers and that countries are willing to share stocks, it is estimated that 29 million tons of wheat, 18 million tons of rice, and 34 million tons of coarse grains would cover 95 percent of the single-year world grain production shortfalls.

Most of the larger shortfalls in rice production have occurred in Asia, especially in India. Reserve stocks of rice would be held primarily to meet contingencies in this area of the world. Wheat, however, has customarily been used to substitute for rice in emergency situations, because rice stocks of any sizable magnitude have not been maintained.

As mentioned earlier, the largest shortfalls in world wheat production during 1960-73 occurred in the USSR, and that country was responsible for 80 percent of the deviation from trend in world wheat imports during the period. If the USSR held stocks sufficient to overcome its production deviations and therefore its large sporadic imports, the level of wheat stocks needed to fill shortfalls in the rest of the world could be reduced by as much as 30 percent.

Grain reserves to meet the past fluctuations (from trends) in world imports would require between 6 million and 12 million tons of wheat and between 3.5 million and 7.5 million tons of coarse grains, depending on the level of protection desired.

Deviations from Trends of Total Grain Production

Adding the amounts of the separate grains that would meet deviations from trends in production gives a total of about 80 million tons, but this amount of world grain reserves would perhaps not be required because it does not allow for substitution among grains. Table 20 indicates that about 56 million tons of grain (including rice) would meet 95 percent of the single-year shortfalls, provided there was perfect substitution among grains.

Thus, depending on the degree of substitution in the use of grains, between 56 million and 80 million tons of grain stocks, over and above working stock levels, would be needed to cover 95 percent of the world production shortfalls from trend for any single year, based on data for the 1960-73 period.[8] While this level of reserve stocks would not meet all possible situations, it would nevertheless provide a fairly high degree of protection. To meet 68 percent of the single-year shortfalls, or 2 out of 3, the world would need roughly 25 million to 40 million tons of grain, depending on the degree of grain substitution. This level of stocks would provide a lower level of protection and permit more fluctuation in grain prices.

The worldwide shortfall in 1972 and the poor 1974 grain crop give cause for concern about the possibilities of repeated shortfalls or limited production increases. Taking account of the possibilities for consecutive bad crops may lead to suggestions for increases in the reserve levels estimated above. But, while most stock level estimates are designed to meet a one-year shortfall, they also provide considerable protection for other possible contingencies. If consecutive shortfalls were only mild downturns, stocks held at the "95-percent level" would be more than sufficient. Stocks adequate to meet all possible situations might be very large and expensive. At lower stock levels, however, some price instability may have to be borne. This price instability may not be totally undesirable, in that it would signal agricultural producers around the world to make production adjustments.

It is not imperative that all of the deviation from trend for world production or consumption be covered. Some belt-tightening, for example, by a reduction in the amount of grain fed to livestock could be achieved rather easily. A variety of grain storage (insurance) schemes could be developed to cover only part of the shortfalls. For instance, a country might be expected to provide from domestic sources enough grain to cover a 5- or 6-percent shortfall before international stocks would become available. This could greatly reduce the size of needed stocks and their cost.

[7] The results of an FAO analysis based on a somewhat longer time period do not differ substantially from the results reported in tables 18 and 20.

[8] This estimate assumes no barriers to trade and that surplus countries are willing to share supplies with deficit countries. If these assumptions do not hold true, then a higher level of reserves would be needed to give the same level of protection. This analysis also assumes that the world reserve stock level would offset the shortfalls in any single year. If shortfalls occur in consecutive years or if surpluses are not large enough to build stocks back up to the stated levels before a second shortfall occurs, then larger stock levels would be necessary to give these same levels of protection. FAO has also made some estimates of minimum safe stock levels for the world. They have calculated that between 66 million and 71 million tons of grain reserves for the world would be necessary. In addition to this reserve element, their estimates for desired world working stocks are 159 million tons (based on 12.5 percent of world consumption), which would bring the amount of total carryover stocks needed in the world to 225 million to 230 million tons. See *World Food Security: Draft Evaluation of World Cereals Stock Situation,* op. cit.

Table 18—Wheat and coarse grain reserve stock levels needed to even out shortfall deviation from trend in yield (assuming constant 1973 acreage), production, and import demand, 1960-73

Region	Wheat			Coarse grains		
	Yield[1]	Production	Import demand[3]	Yield[1]	Production	Import demand[3]
			million metric tons			
World						
95% level[2]	32.1	29.4	12.4	29.6	34.2	7.4
68% level[2]	14.7	13.5	5.7	13.6	15.7	3.4
Max. shortfall 1960-73[4]	23.5	20.4	10.0	20.4	20.7	5.1
Developed countries						
95% level[2]	11.7	16.8	3.1	25.3	33.1	4.8
68% level[2]	5.3	7.7	1.4	11.6	15.2	2.2
Max. shortfall 1960-73[4]	9.1	17.8	2.5	26.5	23.7	4.3
Less developed countries						
95% level[2]	6.0	5.9	5.4	5.5	9.4	3.1
68% level[2]	2.8	2.7	2.5	2.4	4.3	1.4
Max. shortfall 1960-73[4]	4.2	4.5	5.2	3.6	5.9	2.6
Centrally planned countries						
95% level[2]	29.9	24.4	11.8	17.6	15.7	5.0
68% level[2]	13.7	11.2	5.4	8.1	7.2	2.3
Max. shortfall 1960-73[4]	24.6	20.5	9.8	13.0	10.9	3.1

[1] Yield deviations from trend during 1960-73 were expressed in percentage terms and applied to 1973 production trend figures to give the potential shortfall resulting from yield. [2]The 95 percent level and the 68 percent level refer to the percent of shortfall deviations from trend that would be covered by the reserve stock levels stated. These reserve stock levels are based on the standard error of estimate of the trend equations and critical t values of 2.179 and 1.000, respectively. The 95 percent level is akin to meeting 19 out of 20 shortfalls and the 68 percent level, 2 out of 3 shortfalls. These percentages refer to the number of *shortfalls* covered. An alternative way of viewing the issue is to consider what percent of the *time* that these reserve stock levels will cover the shortfalls. To say that 95 percent of the shortfalls will be covered is equivalent to saying that 97.5 percent of the time, the reserve levels would be adequate to cover any shortfalls that occur. The difference in these two percentages arises from the fact that this analysis has been concerned with only the shortfall deviations from trend. With the assumption that total deviations from trend are normally distributed (which, given the small sample size, is approximated here by a t distribution) the shortfalls would be expected to occur half the time. Thus, for any single year the probability that the indicated reserve stock levels will be adequate to cover any shortfall is 0.975, i.e., 97.5 percent of the time any one-year shortfall will be covered.

Following the same reasoning, to say that 68 percent of the shortfalls will be covered is equivalent to saying that any shortfall that occurs will be covered 84 percent of the time. The probability that in any single year the reserve stock levels will cover any shortfall is 0.84. [3]In case of import demand, the stock level figure represents the above trend value. [4]See footnote 2 of table 20.

Source: W. Scott Steele, The Grain Reserve Issue, ERS, 1974 (unpublished).

Table 19–Rice reserve stock levels needed to even out shortfall deviations from trends in production, 1960-73

Region	95 percent[1] of shortfalls covered	68 percent[1] of shortfalls covered	Maximum[2] shortfall during 1960-73 covered
		million metric tons	
World	18.3	8.4	15.3
World, excl. PRC	16.6	7.6	12.4
World, excl. India	9.2	4.2	7.9
World, excl. PRC, India	6.8	3.1	5.5
World, excl. Asia	1.7	.8	1.1
Asia	15.0	6.9	12.9
Asia, excl. PRC	16.3	7.5	11.1
PRC	4.4	2.0	4.0
India	10.7	4.9	8.0

[1] Reserve stocks for rice have been calculated on an unmilled basis. To convert to a milled basis, the reserve levels should be multiplied by a factor of about .68. [2] See footnote 2 of table 18. [3] See footnote 2 of table 20.

Table 20–Reserve stock levels for total grain, including and excluding rice, and food grains needed to even out shortfall deviations from trends in production, 1960-73

Region	95 percent of[1] shortfalls covered	68 percent of[1] shortfalls covered	Maximum[2] shortfall during 1960-73 covered
		million metric tons	
Total grain excl. rice:			
World	52.5	24.1	31.7
Developed	40.9	18.8	40.6
Developing	6.5	3.0	4.2
Centrally planned	34.6	15.9	29.2
World, excl. exporters	34.9	16.0	32.3
World, excl. exporters and USSR	20.9	9.6	19.2
Total grain incl. rice:			
World	56.4	25.9	40.6
Developed	40.9	18.8	40.8
Developing	19.2	8.8	12.6
Centrally planned	35.9	16.5	33.0
World, excl. exporters USSR and India	21.1	9.7	12.5
India	10.0	4.6	7.1
Food grains:			
World	33.6	15.4	25.3
Developing	17.2	7.9	12.9
Excl. India	10.5	4.8	10.4
India	12.2	5.6	7.4

[1] See footnote number 2 of table 18. [2] Refers to the amount of reserve stocks needed to cover the maximum actual shortfall, or in the case of import demand, the maximum above-trend fluctuation, which occurred during 1960-73. It should be noted that the actual maximum shortfall during 1960-73 was, for the world as well as for each region, less than the indicated reserve necessary to cover shortfalls at the 95-percent level. The reason for this difference is that the statistical test used corrects for a theoretical understatement of the shortfalls because of the small sample of years. If the objective for holding reserve stocks is to meet the maximum actual shortfall which occurred during 1960-73, then 40.6 million tons in the case of total grain, including rice, would be eld. [3] Rice has been included on an unmilled basis.

Who Would Hold Stocks?

In the past, the United States and Canada held most of the world's carryover reserves of grain. Most of the reserve stocks in the United States were held under Government programs. In 1961, 109 million tons of wheat and coarse grains—65 percent of total world carryover grain stocks (excluding the USSR, the PRC, and East Europe)— were held under U.S. Government loan and storage programs.

As a result of recent events, U.S. Government stocks have been depleted and almost all U.S. stocks are now held by the private sector. Beginning U.S. grain stocks for 1974/75 are estimated to have been about 27 million tons, down from 41 million tons a year earlier. U.S. officials have stated their opinions that, since grain stocks benefit the entire world, other countries should share in the costs of holding them. The present world grain stock level and the stock level in the United States have been very much affected by recent exceptional events. Having relied on the United States to hold stocks, many countries have not been accustomed to, nor do they have the facilities and machinery to, hold large amounts of stocks.

Presumably, the private sector (farmers, grain traders, processors, etc.) will adjust their stock-holding positions to their expectations of the balance between the costs and expected financial advantages of holding stocks. However, their evaluation of the risks of possible gains and losses from stock holding will be greatly affected by the extent to which governments try to manage world grain markets. Under some circumstances, the private sector may be quite efficient in accumulating and disposing of stocks, and may contribute to overall efficiency in the production and marketing of grains. This seems very likely to be the case when stocks are carried through the marketing year from one harvest to the next.

However, as the FAO study has noted, and as some other studies have concluded, there are not likely to be sufficient "private incentives to hold stocks against unforeseen crop failures, or successive poor crops."[9] But it is precisely the problem of such crop failures and their unfortunate impact that has made the question of who holds reserve stocks a major issue today.

Where Would Stocks be Held?

Traditionally, grain stocks have been held mainly in exporting countries. These countries have developed grain storage capacity and the marketing, administrative, and organizational mechanisms to handle the storage and shipment of large quantities of grain. While it may be desirable for larger grain stocks to be held in countries such as the USSR and India, where shortfalls are especially likely to take place, physically locating grain stocks in a large number of places would greatly complicate the problem of mobilizing these supplies if a serious need arose.

For this reason, establishing large amounts of additional capacity in developing countries, or even in countries with reasonably consistent net import trends, is questionable. However, some increase in the storage capacity of a greater number of producing countries is probably desirable. The question of the physical location of stocks is, of course, very different from that of who is to own or who is to share the cost of holding them. Stocks could be held in one country but owned by another as long as there was assurance that such stocks would be available to the owning country on demand.

Costs of Holding Stocks

The costs of holding stocks will depend on how long the stocks are held, the quantities held, and the storage and interest charges, which, in turn, depend on how long stocks are held. If stocks were held to cover all contingencies, the quantities would be large and used very seldom. Assuming annual interest and storage charges of approximately $10 per ton, the cost to the world of holding reserves to meet most of the world's shortfalls in grain production would amount to approximately $550 million to $800 million a year.[10] These costs might be shared among countries of the world in relation to their financial ability or according to the degree of variation in grain production, or in relation to benefits received from a reserve program.

Possibilities for Reducing the Need for Stocks

Part of the reason for the rapidly shifting agricultural, including trade, events of 1972-74 was a lack of widespread knowledge about what was happening to the world food economy and a lack of coordination among the decisions of producers and importers of grains. If a better information system existed, if better forward planning occurred between importers and exporters, and if appropriate adjustments in production patterns were made, this might reduce some of the uncertainty of the past. A reduction of uncertainty by these means could reduce the amount of stocks needed.

[9] FAO, *World Food Security*, op. cit.

[10] Annual interest and storage charges are representative of pre-1973 costs. Costs of holding reserves exclude the cost of acquiring the grain which could be recovered when the grain is released from stocks. If grain reserves were accumulated at the present high prices and interest rates, the total cost of storing grain is more likely to fall in the range of $15 to $20 per ton.

Current Information System—Coverage and Shortcomings

Statistical and intelligence activities relating to world food and agriculture are carried out by FAO and by a number of countries in the world. FAO relies very heavily upon the national governments of the developed countries for statistical information. A large part of its funds and personnel are devoted to data gathering in the developing countries, where FAO maintains about 50 technical assistance personnel to help in developing agricultural statistics. For the past 25 years, much of this assistance has gone into planning and training for decennial censuses. FAO is now trying to shift its emphasis to the provision of annual estimates.[11]

The current FAO system of statistical food intelligence is based heavily upon the statistics of (1) major exporting countries of food and feed grains, primarily the United States, Canada, Australia, and Argentina, which have good statistical systems; (2) major commercial importing countries of Western Europe and Japan, which have well-developed statistical systems and make their information available; (3) countries such as the USSR, the People's Republic of China, India, Bangladesh, and Brazil, which have limited information systems or make limited amounts of information available; and (4) more than 100 underdeveloped countries whose statistical systems are not well-developed.

While the statistics of the developed countries with respect to current developments are reasonably good, those of the developing countries usually come too late to be used as a basis for decision making. To improve on this information gap, FAO created an "Early Warning System for Food Shortages" in 1968 to keep abreast of national crop failures and their possible impact on the world food situation and shortages. The "early warnings," however, are essentially nonquantitative.

A major element of the FAO proposal for world food security is for an information exchange system which would improve the early warning system so that appropriate action could be taken in time to deal with potential crisis situations. To achieve this goal, cooperation and support from all major exporting and importing countries are needed. The Soviet Union is not a member of FAO and has not yet endorsed the principles and objectives of the FAO proposal. Development of an effective international food security system will require solution of the problem of Soviet participation or nonparticipation.

While a much improved information system could reduce the degree of uncertainty in the world, it would not, of course, greatly reduce the variability in production. Furthermore, the large statistical and current estimate systems in developed countries, such as the United States, have not been successful in predicting near-term developments until well along in the production year—especially in years of significant deviations from normal weather patterns. Thus, a better information system could help to deal more effectively with problems as they develop and could help alleviate speculative price fluctuations. But it is not likely to reduce the need for stocks if they are defined to provide supply stability.

[11] Arthur B. Mackie, "The Role of Information on the World Food Economy and Current Information Systems," Economic Research Service, unpublished.

Long-Term Contracting

Firm forward delivery contracts for agricultural commodities that extend 2 or 3 years in the future are not widely used. Forward contracts, if they tied down a substantial portion of the available export supply, could result in even larger fluctuations in the price of the smaller supplies not under contract, as is now the case with sugar. Beyond 12 to 18 months, price uncertainties are extremely large, and unless quantities and prices are fixed, such contracts are of limited use. Therefore, extensive use of firm forward delivery contracts for agricultural commodities covering a 2- or 3-year period is not a likely prospect for private market participants.

Production Adjustments

The rapid reduction of wheat area in the United States, Canada, Australia, and Argentina in the late 1960's, and the increase in their wheat area in 1973 and 1974, indicate the possibility for using large production adjustments as part of programs to ameliorate the impacts of unforeseen fluctuations in production. These production adjustments could reduce the need for very large stocks and help to replenish reserves that have been used. However, relying on area adjustments for quick increases in production presupposes the existence of unused resources of land, fertilizer, and other inputs, as well as an appropriate set of price signals.

The grain exporting countries are the only ones which have had idled land and the mechanized capacity to quickly bring such land into production. As 1974 has demonstrated, however, other resources, especially fertilizer, were much less flexible and the weather cannot be counted on when increased production is desired. The full-scale effort to expand grain area and production in the United States in 1974 placed an additional burden on the world's fertilizer supplies, but production fell sharply below expectations because of poor weather.

Production adjustment is therefore an undependable device for augmenting stocks in the short run (1 or 2 years). While the existence of idled land was a

characteristic of the past decade, it seems quite unlikely that other resources such as machinery, fertilizer, etc. would be consistently in oversupply. Production adjustment would be more effective in limiting stocks once reserves were rebuilt, but this too involves the problem of idling not only land but other resources.

An International Stocks Arrangement?

The FAO proposal calls for a system of nationally held stocks with an exchange of information and international consultation. There have been several other proposals ranging from a world food bank to international commodity agreements. Of all the proposals, it is thought by many observers that the FAO proposal probably has the best chance for success. FAO's largely voluntary approach would not overburden a few countries with maintaining reserves for the rest of the world. Exporting as well as importing countries would share the responsibility. If properly implemented by all major exporting and importing countries, the FAO food security program could have the merit of reducing the probability of acute food shortages and moderating severe price instability.

Ideally, of course, the objective of an international stocks arrangement would be to maintain an equitable and more stable price for producers and consumers, and to stimulate efficient production of an adequate supply of food. In practice, however, the management of stocks is a political issue influenced by pressures from consumers, producers, taxpayers, exporters, and importers. Too large or too small a stock level will produce unsatisfactory results. In the present situation of rapidly growing population, high food prices, high rates of inflation, and increasing international interdependence, the world clearly has a vested interest in producing and distributing food in adequate quantities and at prices that stimulate needed production and reduce wasteful uses.

6. NUTRITION

About one out of six people in the world is undernourished. Most live in the developing countries, where food production is insufficient. The daily caloric intake there averages only about 2,000 calories, compared with 3,000 in the developed countries. Grain comprises about two-thirds of the diet in the developing countries. To close the nutritional gap would take only about 2 percent of world grain production, but the problem would be to collect and deliver the grain to the malnourished people.

In the past, food aid has served partly to reduce market prices to consumers in the developing countries. To make more grain available for direct human consumption, it has been suggested that grain be diverted from livestock and poultry feeding in the developed countries. However, at best, that would seem to be merely a short-term emergency solution as, in the long term, grain production would adjust to the reduced demand.

Consumption Levels

Food consumption per person in 1964-66 ranged from a low of 1,969 calories in the East Asia and Pacific region to over 3,100 in many developed countries. The average was 2,097 for the developing countries (including Asian centrally planned economies) and 3,043 for the developed countries (including the USSR and Eastern Europe) (table 21). In 1969-71 the average had risen to about 2,200 in the developing countries, and to about 3,150 in the developed countries.[1]

In the developed countries, a little more than one-third of the calories came from direct consumption of cereals, compared with about 62 percent in developing countries. The average person in developed countries consumes nearly three times as much sugar, more than four times as much meat and fats and oils, and about six times as much milk and eggs as the average person in developing countries.

[1] U.N., *Assessment of the World Food Situation*, op. cit.

Importance of Cereals

Although very dependent on cereals for direct human consumption, the developing countries have low levels of production and consumption per capita, compared with the developed countries (table 22). Of the grain used in the United States and Canada, less than 10 percent is consumed directly for food. Over 90 percent is fed to livestock, producing the high level of livestock-product consumption typical of developed countries. In South and East Asia, practically all of the cereals produced and imported are consumed directly as food—less than 1 kg per capita is fed to livestock.

There is thus a dual dependence of the world on cereals. In many of the developing countries, low incomes necessitate diets composed largely of cereals. As incomes rise from very low levels the consumption of grain increases rapidly, giving a relatively high income elasticity of demand [2] for cereals for direct consumption (ch. 9). However, in North America, Europe, and Oceania, where incomes are relatively high, the elasticity of demand for grain for direct consumption as food is negative, and the amount of cereals consumed per person directly decreases when incomes rise.

Estimated income elasticity of demand for grains for direct consumption [3]

	Wheat	*Rice*	*Cereals*
Asia and Far East	.43	.30	.25
India	.50	.40	.25
North America	−.31	.19	−.25
Europe	−.31	.16	−.29
Oceania	−.10	.01	−.10

While the income elasticity of demand for food is low in the developed countries, and negative for most cereals, the demand for meat, especially beef and veal, is relatively high—more than .50 for North America and .51 for Western Europe. The elasticity of demand for livestock products is even higher in

[2] The income elasticity of demand is a measure of the percentage increase in the quantity demanded of a commodity associated with a 1-percent increase in consumer income.

[3] Consumed directly as food rather than fed to livestock. Source: FAO, *Agricultural Commodity Projections, 1970-1980, op. cit.*

Table 21—Calories per person per day from 11 food groups, 1964-66 average

Country	Region	Cereals	Starchy crops	Sugar	Pulses, nuts & cocoa	Vege-tables	Fruit	Meat	Eggs	Fish	Milk	Fats & oils
Developed												
United States	3,156	649	95	513	103	73	101	598	71	26	397	530
Canada	3,142	670	155	520	73	62	101	622	57	23	378	481
Australia & N. Zealand	3,192	821	101	550	61	47	102	655	52	23	403	377
USSR	3,182	1,544	265	412	60	41	27	240	27	21	252	293
EC-9	3,111	878	179	391	68	59	109	474	50	30	305	568
Eastern Europe	3,080	1,498	183	307	59	49	58	314	31	13	189	379
Japan	2,416	1,397	134	197	146	90	53	53	38	85	62	174
South Africa	2,734	1,583	33	403	55	14	37	254	11	28	147	167
Other Western Europe	2,897	978	191	304	103	69	126	288	38	50	267	483
Average	3,043	1,127	175	388	82	59	76	371	44	32	270	419
Less Developed												
Argentina	2,885	999	180	378	28	30	88	614	24	12	206	326
Mexico & Cent. America	2,425	1,197	107	388	188	14	82	131	16	11	104	187
Other South America	2,276	898	291	363	80	23	62	203	13	21	142	180
West Asia	2,316	1,480	41	187	91	39	113	78	7	4	91	185
China (PRC)	2,045	1,383	224	35	134	33	6	134	12	14	5	65
Brazil	2,541	861	410	401	312	11	48	203	18	13	135	129
East Asia & Pacific	1,969	1,271	245	99	107	27	31	58	7	31	8	85
North Africa	2,290	1,461	104	198	72	43	67	69	5	6	78	187
South Asia	1,975	1,300	29	192	176	35	26	8	1	5	89	114
Southeast Asia	2,121	1,589	70	84	78	29	58	77	8	39	18	71
Africa South of Sahara	2,154	1,109	568	53	180	13	18	61	3	13	32	104
Average	2,097	1,300	191	135	146	30	30	89	8	13	50	105
World	2,386	1,247	186	212	127	39	44	175	19	19	117	201

Source: FAO Food Balances 1964-66.

Table 22—Annual average per capita production and disappearance of cereals, 1969-71

Region	Production	Disappearance
	kgs. per capita	
Developing countries	157	168
East Asia	136	174
South Asia	144	152
Developed countries	571	538
United States	1,000	813
Canada	1,500	932
World	297	300

Source: Foreign Agricultural Service and Economic Research Service.

developing regions (1.06 for meat in Asia and the Far East), but low-income levels place these products largely out of reach for most consumers.

In Japan, Italy, Germany, and Greece, because of rapid economic growth since the 1950's, "real" food expenditures per capita have increased by 60 to 100 percent and consumption of animal protein, by 30 to 94 percent. There is every indication that similar movements in this direction, although not as fast in many developing countries, will be followed in the rest of the world as per capita incomes increase.

Nutrition and Vulnerable Groups

Millions of people in the world suffer from malnutrition. FAO has concluded that out of 97 developing countries, 57 were deficit in food energy supplies in 1970, and has estimated the number of malnourished in the world (excluding Communist Asia) at about 460 million people.[4]

Who Are the Malnourished?

Malnutrition is primarily a function of poverty. Most of the world's malnourished live in the developing countries—in the Far East and Africa. Between one-fifth and nearly one-third of all people living in the Far East (excluding Communist Asia), the Near East, and Africa have an insufficient food supply, compared with only 3 percent in the developed countries (table 23).

Within households in these regions, it is the men, the primary earners of income, who often get first priority in the allocation of food, and when food shortages are especially acute, the women and children may be the most deprived. Children's malnutrition is also affected by their inability to ingest sufficient food when starchy foods are the main staple. FAO has estimated that perhaps one-half of the young children in the developing countries may suffer in varying degrees from inadequate nutrition.

How Much Would it Take to Feed the World's Malnourished?

Cereals alone could conceivably supply the calories and much of the protein needed by the world's malnourished people. The caloric value of most cereals is similar. About 0.15 kilograms daily of wheat, rice, corn, sorghum, or millet would provide 500 calories. If the estimated 460 million malnourished people in the world were each provided daily with additional grain equal to 500 calories, much of the world malnutrition would be alleviated.

[4] U.N., *Preliminary Assessment of the World Food Situation*, op. cit.

Table 23—Estimated number of people with insufficient protein/energy supply, 1970

Region	Population	Percent of population below lower limit	Number below lower limit
	billions	*percent*	*millions*
Developed regions	1.07	3	28
Developing regions excluding Asian centrally planned economies	1.75	25	434
Latin America	0.28	13	36
Far East	1.02	30	301
Near East	0.17	18	30
Africa	0.28	25	67
World (excluding Asian centrally planned economies)	2.83	16	462

Source: U.N., Preliminary Assessment of the World Food Situation, Rome. 1974.

On an annual basis, about 25 million tons of cereals would be needed, about 2 percent of average annual world cereal production during the last decade. The world could rather easily produce 2 percent more grain. But the mere production of 25 million tons more grain would not solve the problem of the world's malnourished.

The most difficult problems are not those of increasing production of food, but of distributing it properly. Nevertheless, it is noteworthy that the amounts of grain needed to eliminate the worst aspects of malnutrition would be only about twice the quantities of grain moved under food aid programs in the past decade.

However, only a small share of food aid has gone directly to the malnourished. Most has gone to reduce prices and benefit all consumers in the receiving countries. Although malnutrition can result when the intake of any essential food element is too low, most of the world's underfed suffer primarily from inadequate caloric intake, which for the developing countries is clearly linked to low incomes.

The best long-run solution to the problem of malnutrition is to develop programs and policies to provide farmers in the developing countries with techniques and assistance to raise their production, and to provide others with employment opportunities to raise their incomes to enable them to pay for adequate diets. For some developing countries, special feeding programs for those most affected by malnutrition may be needed. Fortification of foods, educational programs, and other means may also contribute to improved nutrition.

The Grain-Livestock Issue

Expenditures for food account for only 15 to 16 percent of private consumption expenditures in the United States and Canada, and from 20 to 30 percent in most of Europe and Oceania. Because these percentages are so low and because cereals constitute only a small fraction of the diet in these parts of the world, high cereal prices represent a relatively minor problem for most consumers. If necessary, they can change their patterns of food consumption and still maintain adequate nutrition.

However, in developing countries, and among the poorest in all countries, expenditures for food may take 50 percent or more of private consumption expenditures. Cereals may account for as much as 50 to 70 percent of the cost of food. For these people, a doubling or tripling of the cost of cereals is a major disaster. They have little flexibility in switching to other foods when cereal prices are high—a basic cereals diet leaves only inferior cereals or starchy root crops as an alternative. Consequently, their low level of food consumption must decrease even further when prices of cereals rise.

The current food shortages have given rise to the question: Should people in the developed countries who consume large quantities of grain in the form of livestock products forego some of these products to release cereals for the world's poor? On a calorie or protein basis it is more efficient for people to consume grain products than to feed grain to livestock and then to consume the livestock products. Grain consumed as milled or baked products by people provides two to five times the calories it would if converted to livestock products and then consumed. Furthermore, the protein and other nutrients available in livestock products are not necessarily more nutritious than those in cereals if cereals are consumed in combination with other foods containing complementary proteins and nutrients.

The explanation behind the higher prices for livestock products relative to cereal products lies not only in the greater costs of production, but also in consumer preferences. Many people prefer a portion of their food in the form of livestock products when they can afford it. This is indicated by the high income elasticities of demand for livestock products in nearly all countries. Wherever income levels and price ratios between grain and livestock products permit, grains are fed to livestock. In Australia and Argentina, very little grain is fed to cattle. In these two countries, the value of livestock products relative to grains is not sufficient to permit the feeding of grain to livestock since pastures are relatively abundant.

Even in the United States, pasture and roughage provide most of the feed for livestock.[5] In addition to private self-denial, other measures to reduce the amount of grain fed to livestock could be taken. A variety of policies conceivably could provide opportunities and incentives to do so. In the United States, cattle consume a large share of the grain fed to livestock. Leaner beef could be produced with much less grain. Consumer preferences and the costs of production underlie the relative prices of fat and leaner meat, but changes in grading standards would help consumers adjust their consumption patterns.

In any case, neither government actions to reduce grain fed to livestock, nor voluntary consumer decisions to reduce meat consumption, would directly provide food to the world's hungry. Such measures would reduce the demand for grain and in the short run lower grain prices. Poor, malnourished consumers would benefit from lower grain prices, but so would all other consumers. However, with lower grain prices there would be less incentive to produce grain. It is debatable whether continued deliberate restriction of grain consumption would significantly reduce the

[5] *Livestock-Feed Relationships, National and State,* Statistical Bulletin No. 530, Economic Research Service, USDA.

long-run price of grain. It might merely reduce the quantity available without reducing the price, or it might contribute to a return to grain surpluses and their accompanying familiar problems.

The argument for restricted consumption of livestock products rests largely on the assumption that grain is in short supply, that future grain production possibilities are very limited, and that production would not be very responsive to price changes. Grain supplies are currently tight, but this is a temporary situation which need not persist into the future (chs. 1, 2, and 4).

The dramatic shift in grain prices relative to roughage and meat prices in the United States between 1968-71 and 1972-74 (ch. 3) can be expected to bring about a substantial change in the feeding of grain to livestock. With the price elasticity of demand for meat much greater than that for grain for direct consumption, increases in meat prices produce a much sharper reduction in the quantity of meat demanded (and the quantity of feed grains) than in the quantity of grain demanded for direct consumption. Higher grain prices have also produced demands for meat grading systems to be changed to reduce the amount of grain fed.

There are moral, ethical, environmental, and health arguments for the rich to alter their consumption to benefit the poor which do not need to be justified by the assumption that production possibilities are limited, or that food will be more costly and scarce. Feeding the world's malnourished requires a direct transfer of income or food in the short run, and, in the long run, necessitates improvements in the productive capacity or income opportunities of the poor. Unless an effective institutional mechanism is established to transfer the sacrifices of the rich—in food, resources, or income—to the poor and malnourished, such sacrifices are not likely to be effective.

7. FOOD AID

The large food aid programs of the 1960's were made possible by the buildup of surplus commodity stocks in developed countries. Food assistance, which involves emergency relief as well as efforts to upgrade nutritional levels in needy countries, is provided directly by individual countries and through international organizations.

Food aid is facing such policy issues as: (1) will the developing countries provide food aid when they do not have surplus grain, (2) is food aid a disincentive to greater food production in recipient countries, (3) can the burden of supplying food aid be more widely shared among exporting and importing countries, and (4) can food aid be coordinated with stock piling for world food security?

Developing countries that are dependent on food aid are feeling the most severe impact of tight grain supplies, rising food prices, fertilizer shortages, and oil price increases. These conditions are limiting the short- and medium-term prospects for food aid to and food production increases in developing countries. But continued population growth is increasing their need for food. These developments are, however, generating renewed interest in food production and focusing attention on the issues surrounding food aid.

Most of the food aid efforts of the past were made possible by surplus stocks of grains and other commodities which no longer exist. The problem of food aid is therefore much more difficult and would require a genuine sacrifice. The value of total U.S. food aid (under Government programs) has remained fairly constant at around $1 billion in the 1970's. But the volume of food aid has declined as both the volume and value of commercial exports has risen.

The volume of commodities delivered under the U.S. aid program in 1974 may be the lowest since the mid-1950's, when shipments began under P.L. 480. However, the United States has indicated that it would increase the amount it spends on food shipments to nations in need, substantially increase its assistance to agricultural production programs in other countries, and join in a worldwide system of food reserves.[1]

[1] President Ford, Address to the United Nations General Assembly, Sept. 18, 1974.

Food Aid Developments

The United States accounts for the largest portion of food aid provided to developing countries either through concessional or grant terms. The term concessional refers to sales at less than the market price, whereas a grant is a gift. In recent years, other developed agricultural exporting countries and some developed importing countries have become involved in food aid activities on a bilateral basis. Several multilateral food programs have also evolved as further sources of food to developing countries, primarily on grant terms. Most of these food programs followed from the buildup of surplus commodity stocks that occurred in the 1960's.

In the mid-1950's in the United States, food aid was considered to be a means of distributing surpluses with minimum interference with existing markets, as well as a way to develop new export markets. Food aid came to be viewed as an integral part of the development process in that it could be used as a source of finance for certain projects. It was also meant to improve nutritional levels, thus contributing to raising the productivity of the recipients and their effectiveness in development efforts. U.S. food aid also provided emergency assistance—refugee, disaster, general welfare, and special emergency relief.

World food aid programs are both bilateral and multilateral. Table 24 shows the combined value of both types of programs, by donor countries, for 1960 and 1965-73. Of the nearly $11 billion worth of aid provided between 1965 and 1972, the United States accounted for 80 percent, Canada for 7 percent, Japan for nearly 3 percent, Germany and France for around 2 percent each, and other developed countries for the remaining 6 percent. These amounts represent the total value of those food aid contributions given or sold to developing countries at less than market prices. They are not a measure of the "concessional" or aid component, i.e., they do not measure the cost to the donor, or the benefit to the receiver of food aid.

Bilateral Food Aid

Except for the United States, almost all food aid programs are grant rather than concessional (table

Table 24—Value of bilateral and multilateral food aid contributions (disbursements) of developed countries to multilateral agencies

Country	1960	1965	1966	1967	1968	1969	1970	1971	1972	1973	Total 1965-73	Percent of total
						million dollars						
Australia	2.0	10.2	12.6	15.6	8.8	15.1	20.9	12.6	18.5	19.6	133.9	1.22
Austria	–	–	–	--	–	1.0	0.5	0.8	0.8	0.8	3.9	0.04
Belgium	0.1	0.3	0.2	0.2	0.2	2.9	3.3	7.4	11.1	16.0	41.6	0.38
Canada	40.8	57.3	138.3	117.5	63.2	63.3	98.2	88.5	87.8	95.9	810.0	7.37
Denmark	0.1	0.2	0.9	1.6	2.5	8.4	6.7	7.3	8.0	13.9	49.5	0.45
France	0.4	0.7	1.0	1.0	1.0	15.1	14.6	34.8	32.3	66.0	166.5	1.51
Germany	–	2.6	2.6	2.7	2.7	36.6	29.2	46.9	58.4	91.9	273.6	2.49
Italy	–	--	1.5	1.0	0.5	4.5	17.8	24.0	20.0	27.4	96.7	0.88
Japan	0.1	0.4	0.4	0.5	0.5	2.0	23.8	134.5	34.6	105.8	302.5	2.75
Netherlands	–	1.1	0.4	0.9	0.1	13.8	17.1	15.7	20.3	33.0	102.4	0.93
New Zealand	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	1.2	1.2	0.01
Norway	0.3	0.6	2.0	1.2	8.5	4.5	6.1	4.1	2.5	3.9	33.4	0.30
Portugal	–	–	–	--	–	0.1	–	--	0.1	0.1	0.3	0.00
Sweden	–	–	1.2	2.9	4.2	4.7	9.9	9.4	6.5	11.2	50.0	0.45
Switzerland	0.5	1.1	1.1	3.1	4.1	6.8	6.4	4.1	7.6	8.5	42.8	0.39
U.K.	1.0	1.4	2.3	1.0	1.9	17.4	16.0	17.3	2.7	14.3	74.3	0.68
U.S.	901.0	1,234.4	1,213.0	1,007.0	1,060.0	907.0	860.0	826.0	978.0	730.0	8,815.4	80.15
Total, non-U.S.	45.3	75.9	164.5	149.2	98.2	196.2	270.5	407.4	311.2	509.5	2,182.6	19.85
Total, developed countries	946.3	1,310.3	1,377.5	1,156.2	1,158.2	1,103.2	1,130.5	1,233.4	1,289.2	1,239.5	10,998.0	100.00

Source: OECD, "The Food Situation in the Developing Countries," Feb. 1974, and U.S. Department of Agriculture.

25). The six original members of the European Community are shifting from bilateral programs to the multilateral mechanism of the Commission of the European Community.

U.S. Program

U.S. food aid began in 1955 under P.L. 480 as a temporary measure for surplus disposal. In January 1967, the purpose and structure of P.L. 480 legislation were altered. Sales were made under provisions of a new Title I, and donations, under a new Title II. Title I authorized sales of U.S. farm products for convertible local currencies and for dollar credits. Such sales totaled $573 million between June 1973 and July 1974, compared with $659 million in the previous year. Title II authorized famine relief and donations of food, both directly to governments and through voluntary and international organizations. In recent years, the grant element in total food aid has declined, and concessional sales for long-term dollar credit have become larger.

The leading recipients of U.S. food aid shipments in fiscal year 1974 were South Vietnam, Cambodia, India, Bangladesh, Pakistan, the Philippines, Israel, Morocco, Republic of Korea, and Indonesia. The principal commodities provided were wheat, feed grains, rice, soybean oil, and dairy products. The quantities shipped equaled an estimated 3.7 million tons—about half the fiscal 1973 level. The U.S. contribution dropped to about half of total food aid and concessional sales by all countries during the period, including 2 million tons of food aid from the USSR.

U.S. emergency food aid has been provided under Title II of P.L. 480 in the form of government-to-government donations for disaster, refugee, and special emergency relief, donations through U.S. voluntary relief agencies, and donations to the World Food Program.

Under Title II, agricultural commodities have been donated to help alleviate famine and meet other extraordinary relief requirements; to combat malnutrition, especially in children; to promote economic and community development; and to provide food for nonprofit school lunch and preschool feeding programs in several developing countries. The principal recipients of U.S. emergency food aid in fiscal 1973 were the countries of Central West Africa (Sahel drought area), Laos, Pakistan, Sudan, and Yemen.

Title II contributions to the World Food Program totaled $55.2 million in fiscal year 1974—about 50 percent larger than for fiscal year 1973. A total of $3.9 million went for emergency and disaster relief in 1973.

The value of commodities shipped under Title II under the regular and special emergency food aid programs in fiscal year 1974 totaled $122 million, 12 percent of the value of all exports under P.L. 480.

The Title II program has shifted over time to putting emphasis on providing nutritionally significant types and amounts of food to people judged most vulnerable to the effects of malnutrition—pregnant and nursing mothers and preschool children.

Multilateral Food Aid

The major multilateral programs are the World Food Program (WFP), the Food Program of the Commission of the European Community (CEC), and the Food Aid Convention (FAC).

The World Food Program

The WFP, a joint program of United Nations members and the Food and Agriculture Organization, was established as a 3-year experimental program in 1962, but was given permanent status in 1965. It has a membership of more than 100 countries, including the OECD countries, and 88 developing countries. Since 1962, the developing country members have contributed 2 to 5 percent of total WFP aid. The major donors have been the United States, which has contributed 46 percent of the total value of WFP aid since 1962, followed by Canada with 13 percent, the EC, 11 percent; Switzerland, 7 percent; and Denmark and the Netherlands, each with 6 percent.

The value of WFP aid increased between the 3-year pledging period 1963-65 and the 2-year pledging period 1969-70 from $85 million to $320 million. Total contributions for 1971-72 declined and the pledging target of $300 million established for the WFP was not met. The target for the 1973-74 biennium of $340 million was surpassed by $10 million. For the 1975-76 biennium, the United States has pledged to underwrite up to one-third of the $440 million WFP budget target. High prices have reduced the quantity of food assistance financed under the program.

WFP aid is in the form of grants only. Most donor pledges have been commodities. but approximately 28 percent have been in cash and services such as maritime transport, insurance, and supervision of operations.

The largest portion of WFP aid has been used as a wages fund for labor-intensive development projects, such as construction of storage facilities, road construction and repair, minor irrigation works, and community development. Some 10 to 15 percent of WFP grants have been used in special programs providing food to vulnerable groups. WFP commodities have also been used for emergency relief to the drought-stricken Sahel countries.

Table 25–Bilateral and multilateral food aid contributions of developed countries, estimated disbursements,1973

Countries	Bilateral			Multilateral grants				Total
	Grants	Loans	Total bilateral	EC	WFP	Other	Total multilateral	
				million dollars				
Australia	18.7	--	18.7		0.9	--	0.9	19.6
Austria	--	--	--		0.8	–	0.8	0.8
Belgium	5.0	–	5.0	10.7	0.3	--	11.0	16.0
Canada	65.3	9.8	75.1		19.9	(0.9)	20.8	95.9
Denmark	2.6	--	2.6	1.7	9.6	--	11.3	13.9
France	30.3	–	30.3	35.6	0.1	--	35.7	66.0
Germany	37.5	–	37.5	41.8	12.6	–	54.4	91.9
Italy	--	--	–	27.4	–	--	27.4	27.4
Japan	7.5	97.0	104.5		1.3	–	1.3	105.8
Netherlands	6.1	–	6.1	16.0	10.9	–	26.9	33.0
New Zealand	(0.8)	–	(0.8)		0.4	--	0.4	1.2
Norway	0.2	–	0.2		3.7	–	3.7	3.9
Portugal	(0.1)	–	(0.1)		--	–	–	0.1
Sweden	–	–	–		6.6	4.6	11.2	11.2
Switzerland	5.5	--	5.5		2.6	0.4	3.0	8.5
United Kingdom	–	–	–	12.6	1.7	–	14.3	14.3
United States	251.0	425.0	676.0		27.0	27.0	54.0	730.0
Total	430.6	531.8	926.4	195.8	98.4	32.9	277.1	1,239.5

Source: OECD, "The Food Situation in the Developing Countries," February, 1974 and U.S. Department Agriculture.

The Food Program of the Commission of the European Community

The European Community has recently become a fairly substantial donor of food aid to developing countries. This growth was the result of large surpluses of grains and dairy products created by high producer prices for these commodities under the Community's Common Agricultural Policy. Unlike the financial and technical assistance extended by the Community through the European Fund for Development (EFD), which is restricted to Associated Members and Territories of the Community, food aid may be provided to any developing country. Recently, substantial grants have been made to the Sahel countries and to Bangladesh.

The Community's food aid program is financed from the budget of the Commission of the European Community (CEC). In the 1973-74 biennium, the food aid budget amounted to $227 million. The budget provided for 1,287,000 tons of food grains, mainly wheat, which is the Community's total annual commitment under the Food Aid Convention discussed below. An estimated $300 million in food aid is expected to be provided in the 1974-75 biennium.

On the average from 1969 to 1972, CEC food aid was composed of two-thirds dairy products and one-third cereals. Most of the dairy products in CEC food aid are pledged for distribution through the World Food Program. CEC food aid is given exclusively in the form of grants to recipient countries, most of whom are among the least developed.

The Food Aid Convention

Another multilateral mechanism which grew out of exporting nations' efforts to cope with chronic wheat and grain surpluses is the Food Aid Convention. It was created as part of the International Grains Agreements of 1967 and has three basic goals: (1) to encourage developed countries to share the burden of providing food aid to developing countries, (2) to improve the prospects for wheat trade by making surpluses available to countries unlikely to make commercial purchases, and (3) to assist developing countries which are wheat exporters by directing non-producing members of the Convention to purchase a fixed proportion of their wheat imports from the developing countries.

Contributions under the Food Aid Convention may be made bilaterally to recipient countries or through the World Food Program. The United States uses the former method, while the EC has used the second in sending its surplus dairy products to developing countries. The Food Aid Convention has been criticized because the largest part of its food aid does not represent an addition to existing contributions. Nevertheless, the Food Aid Convention, as does the WFP, represents recognition of the principle of wider sharing in food aid efforts.

Policy Issues

The nature and magnitude of bilateral and multilateral food aid programs raise a number of policy issues:

1. *Surplus disposal or conscious programs.* U.S. and other food aid programs resulted from surpluses, particularly grains, during the 1960's. A major policy issue is the willingness of developed countries to commit resources to food aid in periods of shortage as well as surplus.

2. *The objectives of food aid.* There is broad consensus among the developed countries that food aid should be made available in the event of natural disasters or other emergencies. Also, it is widely agreed that special assistance may be required in the short run by developing countries hard hit by rising food, oil, and fertilizer prices.

   There is less agreement on the use of food aid on a medium or long-term basis for development assistance. In the absence of surpluses, food aid should be considered as an alternative to other forms of aid. Thus, it should be evaluated in terms of its contribution to development efforts in relation to other forms of aid. The disincentive effect that long-run food aid might have on agricultural production in the recipient country must be considered.

3. *Wider sharing of food aid efforts.* As the events of 1972-74 demonstrate, the United States can not always be the main residual supplier of the world's food needs. In the last half of the 1960's, the United States accounted for about 90 percent of total world food aid. Since 1970, the food aid programs of other developed countries have grown substantially, while the value of U.S. assistance has been leveling off. However, the total quantity of food aid has declined and cannot be increased unless additional financial commitments are made.

8. FACTORS AFFECTING THE SUPPLY OF FOOD

Although the world now uses only half the land area potentially suitable for crop production, most of the additional land lies outside the densely populated countries. Thus, a good part of future food production gains will have to come from yield-increasing techniques—more fertilizer, improved seed varieties, better cultural practices, and so on.

The long-run prospects for fertilizer supplies at reasonable prices appear to be good. The continuing impact of improved production technology is evident in the increasing grain yields in the developed countries and in the archievements of the high-yielding varieties programs in developing countries. Development and utilization of irrigation water has not reached its full potential around the world. There is much discussion pro and con about changes in climate, but the evidence is inconclusive.

The world's ability to supply food depends on (1) the availability and use of land and other resources, (2) technology for raising yields and increasing the efficiency of crop and livestock production, (3) weather, and (4) incentives to producers. The efficiency of food marketing and distribution systems and the size, organization, and management of agricultural enterprises also influence food supply.

Recent food developments have been seen by some as indications that the world is running out of land on which to produce food; that crucial yield-raising inputs, especially fertilizer, are becoming scarce; that future increases in yields will come more slowly and will be harder to achieve; and that the world's weather is changing—becoming more erratic and less favorable for food production. Some have speculated that because of these conditions, food will be more difficult to produce in the future, prices will be higher, and supplies will be less stable than in the past.

Land

Availability

Running out of land on which to produce more food has been a concern from time to time since 1796, when Malthus put forth the idea of a limited quantity of land and the unlimited growth of population, and drew from this concept profound and discouraging implications concerning the future of mankind. Although new sources of land and new ways of increasing food production have materialized after each successive wave of anxiety about food supplies, the uneasiness about land availability persists.

Several recent studies on land availability have come to essentially the same conclusion: at least twice as much land is physically suitable for crop production as is presently used. An FAO survey of land suitable for crop production, part of its *Indicative World Plan*, the most detailed and comprehensive study yet undertaken to determine the future possibilities for world food production,[1] concluded that land used for crops in the developing countries in 1962 was only 45 percent of the available cultivable land (table 26). Of the total land area in developing countries (excluding the Near East), just 26 percent was found to be suitable for crops, but less than half of that was actually used in 1962. Parts of Asia and North West Africa are approaching the limit of available land for traditional forms of crop production (irrigation potential was excluded from the calculations) because of heavy population density in Asia and large desert areas in Africa.

A more recent study, undertaken by Iowa State University, considered topography, water availability, the absence of serious problems such as alkalinity, the types of crops and forages which could be grown, possibilities for multiple-cropping, market and trans-

[1] *Provisional Indicative World Plan for Agricultural Development*, Food and Agriculture Organization of the United Nations, C 69/4, 2 vols. Aug. 1969.

Table 26—Land used for crops and potential use, developing regions[1]

Region	Land suitable for crops	
	mil. ha.	*percent of total land*
Africa, So. of Sahara	304	19
Asia & Far East	252	47
Latin America	570	29
N.W. Africa	19	6
Total or average	1,145	26

Region	Land used to produce crops, 1962	
	mil. ha.	*percent of suitable land*
Africa, So. of Sahara	152	50
Asia & Far East	211	84
Latin America	130	23
N.W. Africa	19	100
Total or average	512	45

[1] Excludes Near East.

Source: Food and Agriculture Organization of the United Nations, *Indicative World Plan*, vol. 1, p. 49, Aug. 1967.

portation locations, and other important characteristics in estimating land availability.[2] The study estimated that 3.2 billion hectares (7.8 billion acres) of land in the world could be used to grow food crops and raise livestock, but only 1.4 billion hectares (3.4 billion acres) are presently being used.

Although the world as a whole is clearly not running out of land, there are serious regional problems resulting from a combination of population pressure on land and difficulties of increasing agricultural production with the technologies used in these regions. But, as with other resources and economic opportunities, land availability is quite unequally distributed among the world's developing countries. This affects the options available to different groups and different countries. A very large proportion of the world's people live in areas where possibilities for expanding the area cultivated are very limited. India, Bangladesh, and Egypt, for example, must turn to intensive, land-conserving methods of production to increase food production. Latin America and Africa have both intensive and extensive possibilities.

Egypt has only about 7 million acres of land under cultivation, only 3 percent of its total area, because the rest of the country is desert. Bangladesh's agriculture is also constrained by land limits. Most of Indonesia's 130 million people live on Java, Madura, and Bali, where land expansion possibilities are quite limited. But Sumatra, Kalimantan, and the Sulawesies have vast areas of land as yet unoccupied.

A similar situation exists in the Philippines, where people are concentrated in Central Luzon and a few other islands. Java and Bali, Central Luzon, Bangladesh, the Nile Valley, and parts of India have the highest population densities in the world. The latter three areas have few options for expanding agricultural land, but Indonesia and the Philippines seem to have many. However, the people who live in Java, Bali, and Central Luzon are reluctant to move unless they can have a better life in new surroundings. People's roots and traditions, as well as legal, political, and economic constraints, make their location and the conditions prevailing there seem preferable to jungle and remote areas, where land is available in an absolute sense, but where conditions are primitive and far from the amenities of civilization.

New land is constantly being brought under cultivation in many places. The world grain area increased at a compound rate of 0.3 percent annually from 1960 to 1971. The grain area in the developed countries and in the planned economies changed very little, but in the developing countries it increased by 1.1 percent annually. In parts of Africa and Latin America, it increased from 2.0 to 3.7 percent annually.

Bringing new land into production of course requires expenditures of resources and labor, but these costs are not as prohibitive as is sometimes argued. FAO has estimated that to add 5 to 7 million hectares to food production would cost between $137 and $312 per hectare.[3]

The Declining Dependence of Food on Land

As an input to agricultural production, land becomes less important as people learn about and can afford other means of increasing output, and as the costs of expanding land use rise relative to other inputs. The developed countries rely more on nonland inputs and improved agricultural technology than on area expansion to increase food production.

The problem facing many of the developing countries is not simply limited land, but that their land produces so little because of low yields. Between 1960 and 1971, grain area expanded 1.1 percent annually in developing countries, but grain production rose only a little more than 2 percent annually. In the developed countries, grain production increased by 2.5 percent annually, while the area declined.

[2] Leroy L. Blakeslee, Earl O. Heady, and Charles F. Framingham, *World Food Production, Demand and Trade*, Iowa State University Center for Agricultural and Rural Development, 1973. Ames, Iowa.

[3] U.N., *The World Food Problem—Proposals for National and International Actions*, Rome, 1974, pp. 64-67.

Investments in inputs and land improvement could make the land much more productive in many developing countries. If the one-tenth of the world's land area now used for crops were still in "its natural state, it would be vastly less productive than it is today."[4] Even before modern techniques—fertilizer, chemicals, irrigation, and new seeds—were used, major improvements in land were made. Most of the soils of Western Europe were originally very poor, and Japan's soils were originally much inferior to those of northern India today.

In the developing countries, land is especially critical in food production because human labor and farm-produced capital—draft animals, manure, homemade equipment, ditches, and wells—are often the only resources available to the farmer to augment his land's basic production capabilities. The contribution of land to the value of food is thus high. When population presses hard on the land area, those who rent land often pay 50 percent of the value of their crop to the landowner. While tenant and sharecropper relationships may explain part of this, the basic reason is that land makes a large contribution to the value of food in traditional agriculture.

In the United States, increases in food production are to a large extent attributable to increases in non-land inputs, and food prices reflect more and more off-farm value added. Only 5 percent of the retail cost of food in the United States now consists of land rent, compared with 8 percent in 1930. In Great Britain, land rent (including buildings and land improvements) accounted for 40 percent of value added in agriculture in 1855, but for only 7 percent in 1965.[5]

Fertilizer

While the amount of land that could be brought into production is perhaps double that currently used, all recent studies of world food production conclude that outside of Africa and Latin America, yield-increasing techniques will be the primary source of future growth. In the 1960's, only 45 percent of the increase in grain production in developing countries was due to area increases, and in the next decade, this proportion will decline further.

Fertilizer is a key factor in yield increases, although it must be combined with improved varieties of seeds and improved cultural practices if it is to have much impact on yields.

[4] Theodore W. Schultz, *The Food Alternatives Before Us: An Economic Perspective*, Agricultural Economics Paper No. 74:6, May 25, 1974 (unpublished), University of Chicago.
[5] *Ibid.*

Past Trends

World fertilizer production and consumption increased rapidly but unevenly over the past two decades. Consumption of the three major fertilizers (nitrogen, phosphate, and potash, or N, P, and K) doubled between 1950 and 1960 and tripled from 1960 to 1973. The rate of annual increases slowed in the late 1950's, rose rapidly to nearly 11 percent during 1964-67, and slowed to 6.5 percent in 1972. Nitrogen consumption has grown the most rapidly but has also experienced the largest annual fluctuations.

Fertilizer production capacity increased 20 million tons during 1962-67, with the developed countries accounting for 80 to 90 percent of the growth. This expansion was in anticipation of large increases in demand, induced by anxiety in 1963-66 about an approaching world food famine, and was facilitated by important technological changes and the development of specialized transportation and storage facilities. Relatively low energy costs also contributed to growth in production capacity and may have influenced the location of plants in the developed countries.

Fertilizer demand in the last half of the 1960's, was not as great as had been expected, however. Consumption in developed countries (expanding at about 6 percent per year) was slowed by cutbacks in agricultural production and low farm prices. In developing countries, fertilizer consumption grew almost 14 percent annually, but this was still slower than had been anticipated (table 27). Overcapacity and overproduction drove fertilizer prices down from $90-$102 a ton (bagged urea for export) in 1964 to $40-$45 a ton in late 1970. About 20 percent of the existing capacity was closed—the older, less efficient plants.

Western Europe and Japan have been the major fertilizer exporting regions, while the developing regions of Africa, Latin America, and Asia, including the Asian planned economies, have been large net importers (table 28). North America and the USSR also export substantial quantities, but while the exports of the latter have increased sharply those of the former have fallen.[6]

Low prices and ample supplies facilitated a large increase in fertilizer aid shipments by the United States (from 1.9 million tons product weight in 1965/66 to 3.4 million tons in 1967/68) and by other developed countries. They also contributed significantly to rapid adoption of Green Revolution technology in Asia during 1967-71. But the ready availability of fertilizer at low prices—and even lower prices under aid agreements—may have contributed

[6] The largest net exporters are: for nitrogen, Japan and Europe; for phosphate, the United States; and for potash, Canada.

Table 27–Production, consumption, and net trade in fertilizer (N, P, and K)

Item	1962/63	1966/67	1970/71	1971/72	Rates of growth	
					1962-71	1967-71
	---- *million metric tons* ----				---- *percent* ----	
Production						
Developed countries	32.5	49.4	64.0	67.7	8.5	6.5
Developing countries[1]	1.5	2.8	5.3	6.0	16.7	16.5
Asian planned countries	[2]0.5	1.4	2.2	3.0	22.2	16.5
Total	34.5	53.6	71.5	76.7	9.3	7.5
Consumption						
Developed countries	29.5	42.9	56.2	58.9	8.0	6.5
Developing countries[1]	3.2	5.4	9.1	10.1	13.6	13.3
Asian planned countries	[2]1.0	2.5	4.1	4.6	18.5	13.0
Total	33.7	50.8	69.4	73.6		
Net imports						
Developed countries[3]	-3.0	-6.5	-7.8	-8.8	12.7	6.3
Developing countries	1.7	2.6	3.8	4.1	10.3	9.5
Asian planned countries	[2]0.5	1.1	1.9	1.6	13.8	7.8

[1]Excludes Asian planned economies. [2]Estimated. [3]Includes stock changes and losses.

Source: FAO *Annual Fertilizer Review.*

Table 28–Net exports of nitrogen fertilizer, 1967-72[1]

Region	1967	1968	1969	1970	1971	1972
			1,000 short tons			
North America	260	570	1,220	920	630	640
West Europe	2,010	1,980	2,280	1,810	1,730	1,470
East Europe & USSR	-100	10	90	240	440	830
Japan	1,030	1,150	980	1,360	1,560	1,400
Other developed nations[2]	-100	-130	-120	-10	0	-120
Developed regions	3,100	3,580	4,450	4,320	4,360	4,220
Latin America	-370	-520	-560	-530	-65	-690
Developing Africa	-320	-420	-430	-440	-430	-600
Developing Asia	-1,330	-1,880	-1,720	-1,620	-1,190	-1,310
Developing regions[3]	-1,920	-2,820	-2,710	-2,690	-2,270	-2,610
Other Asia[4]	-1,210	-810	-1,430	-1,600	-1,900	-1,700

[1] Negative numbers imply net imports. [2] Includes South Africa, Israel, and Oceania. [3] Excludes Other Asia. [4] Includes PRC, Taiwan, North Vietnam, North Korea, and Mongolia.

Source: Tennessee Valley Authority, *World Fertilizer Market Review and Outlook*, Muscle Shoals, Ala., forthcoming.

to a low level of capacity utilization of fertilizer plants in developing countries (50 to 60 percent) and to the lack of a sense of urgency about the need to build new plants there.

Demand for fertilizer began to grow relative to capacity in the late 1960's and early 1970's, but this change was not reflected in prices until 1972 and 1973. In 1972, prices rose 30 to 50 percent, and in 1973, they doubled the 1971 level. In late 1973, prices rose even more sharply, reaching $300 to $400 per ton.

The Expected Situation in 1975, 1976, and 1980

Supply-demand estimates for nitrogen and phosphate in 1975 and 1976 indicate a very close balance and thus a continuation of the current high prices for fertilizer. Potash supplies will tighten because much of the idle equipment in Canada will require substantial renovation to meet additional demand. Upward price pressure is expected to continue, although not at the rates that prevailed between mid-1973 and early 1974. These prospects assume a level of consumption roughly on trend for the world, but more may be consumed in the developed countries and less in the developing countries. In North America, mainly in the United States, a substantial increase in fertilizer consumption is expected during 1974/75. Increases in fertilizer prices, however, could dampen this demand by 1975/76. Current high prices have caused reduced purchases, particularly by developing countries. Short supplies and the high prices place an added burden on efforts to increase food production in those developing countries where fertilizer is crucial—especially the relatively land-scarce countries of Asia.

High prices have caused manufacturers to use available capacity at near the maximum in the developed countries. The developing countries, however, still have much idle capacity although their operating rates have increased somewhat. Additional improvement in their operating rates could provide the critical margin between shortage and sufficiency.

The supply of phosphate rock is expected to diminish during the next 2 years. Manufacturing capacity appears sufficient, but rock supplies will continue to be tight.

Between 1973 and 1980, world fertilizer consumption is expected to increase at a compound annual rate of 5½ percent. A similar situation exists for all three nutrients, although nitrogen consumption should grow somewhat faster than that of phosphate and potash.

Much new nitrogen capacity is being planned as a result of recent high prices. Since December 1973, capacity for roughly 17 million tons has been announced. Based on the Tennessee Valley Authority's 1980 midpoint demand estimates (except for North America), a substantial surplus of over 5 million tons of capacity could occur.[7] A substantially higher World Bank estimate of demand would still provide a surplus of nearly 2.5 million tons.[8] While these projections indicate an adequate supply of fertilizer, they do not allow for a substantial increase in the rate of fertilizer use. If a major sustained increase in fertilizer use in the developing countries should develop or be fostered, additional capacity would be required.

This possible nitrogen surplus in the late 1970's would be modest, however, and could be eliminated by a slight reduction in output or a slightly faster rate of growth in demand.

In 1973/74, some of the major developed countries reported marginal declines in fertilizer consumption. Among the major developing countries, only Bangladesh reported an actual decrease in fertilizer consumption. Several countries did not increase their consumption, as they had over the previous 5 years. India increased fertilizer consumption only about 3 percent, compared with an average of 13.5 percent since 1967. Thus, limited supplies and high prices were undoubtedly a factor in slowing food production increases in these countries in 1973 and 1974.

Estimates of 1980 fertilizer production and consumption for major countries indicate that India will take China's place as the world's largest net importer of fertilizers, particularly nitrogen. Although India plans to increase nitrogen production by nearly 150 percent, its nitrogen imports will double if 1980 consumption reaches expected levels. China may be roughly self-sufficient by 1980.

Future Prices for Fertilizer

Current record-high fertilizer prices have been caused primarily by a shift in demand (due to high prices for agricultural commodities) coupled with a very limited capability to increase fertilizer supplies in the short run. Recent price increases for energy, particularly oil, have raised fertilizer production costs substantially, especially for nitrogen production, much of which depends directly on hydrocarbon feedstocks such as natural gas, naphtha, and oil. However, increased energy costs account for only a part of the tripled prices of fertilizer products. Compared with increased demand and limited capacity the effects of higher energy costs and higher plant construction costs are relatively minor.

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[7] Based on Richard B. Reidinger, *The World Fertilizer Situation: 1975, 1976, and 1980*, supplement to the *World Agricultural Situation*, Economic Research Service, Oct. 1974.

[8] The World Bank estimated 1980/81 nitrogen consumption at 62.9 million tons. Using their 7.2 percent growth rate, about 58.7 million tons would be demanded in 1980. However, the TVA and World Bank consumption projections are below those of several other estimates.

Fertilizer prices are expected to decline significantly to perhaps $85 to $125 per ton of urea (in 1971 prices) as supply catches up with demand. This would be well above the price levels reached between 1967 and 1971 but not much above the level of 1960-65. Future technological change to lower production costs will not likely overcome increased production costs, as in the past, because of higher construction and energy costs.

Alternative Projections

A fertilizer study by the World Bank has indicated a large production gap in 1980/81 for nitrogen and phosphate, compared to the above assumptions of a surplus. Differences between the two projections are due primarily to differences in assumptions and show up primarily in the supply estimates. Several important possibilities for future fertilizer supplies are illustrated by a comparison of the two projections:

(1) The supply projections in the World Bank study assume that much of the planned production increase in the developed countries will not materialize because of high energy costs. Thus, fertilizer production in the developed countries is assumed to increase only slightly, by less than 5 million tons.

(2) The consumption estimates in the World Bank study are only slightly higher than the above estimates for 1980—2.1 million tons or 4 percent higher for nitrogen, and 0.8 million tons or 2 percent higher for phosphate.

(3) In view of the assumption that the developed countries will not produce additional large quantities of fertilizer, the World Bank study is concerned with creating enough production capacity in the developing countries for them to not only become self-sufficient by 1980/81, but to also supply roughly one-fourth to one-third of the projected gap for developed countries.

As a result, the World Bank study suggests a need for about 14 million tons of added nitrogen and phosphate capacity by 1980/81 in the developing countries, while recent USDA estimates for 1980 indicate a possible surplus of production capacity in the world.

Fertilizer Issues

The current situation has shown that under tight supply conditions, many developing countries which desperately need fertilizer may be unable to bid it away from the developed countries that produce it. They either may be unable to afford it, or they may face restrictive policies by exporters under strong pressure from farmers in their own country. In addition, shipping costs have escalated along with oil costs, further increasing the cost of fertilizer in developing countries.

Developing countries may feel fertilizer has become too vital to their security and progress to depend as heavily on volatile world markets as they have in the past. In the long run, developing countries must greatly increase their fertilizer use, and some of them have substantial resource advantages over the traditional fertilizer exporting countries. The OPEC countries could also increase fertilizer production because of low-cost inputs. They could, thereby, make a major contribution to assisting the poorer developing countries.

Fundamental issues are raised by these contrasting views of the future:

a. Neither the USDA nor World Bank projections suggest a substantial increase in the rate of growth of fertilizer demand over that prevailing in the last half of the 1960's, yet that was a period of relatively slow grain production growth. If faster growth in grain production is desired, especially in the major grain-deficit developing countries, more fertilizer will be needed.

b. There is widespread agreement that the most significant of the many important world food problems facing the world today is the need to increase food production in the developing countries, especially in those where the largest deficits occur. This is not likely to happen when developed countries are able to bid fertilizer away from developing countries in times of shortage and if the rate of increase in fertilizer use in these countries is not expected to accelerate. Chapter 4 (Projected World Food Supply and Demand) of this report demonstrates that if fertilizer use in the developing countries is increased 1 to 1½ percent above the 1960-72 trend, the size of the projected grain deficit in these countries for 1985 could be reduced sharply. This would result if the developing countries use 15 million tons more fertilizer in 1985 than they would if the present trend is extrapolated. To be effective, of course, additional resources and improved production practices would need to be combined with the additional fertilizer, but the issue is clear—there is a relationship between how much fertilizer is effectively used in the developing countries and how large their food deficits become.

c. The issue of whether the needed future amounts of fertilizer are to be produced in the developed, or developing, or the OPEC countries is not one for projections to resolve. The USDA projections indicate that much of the additional fertilizer will come

from the developed countries, where the capital and experience exist, as happened in the past decade. That there are sound arguments for why more fertilizer *should* be produced in both the developing and OPEC countries should not obscure the real difficulties involved. Among these difficulties are the problems of overcapacity and undercapacity that occurred in the fertilizer industry in the past, the problem of serious underutilization of capacity in developing countries, and the problem of generating the desire among the OPEC countries to use some of their new wealth to create fertilizer factories.

Yield-Increasing Technology

In addition to concerns about adequacy of land and fertilizer aroused by current food shortages, questions have been raised about whether technological improvements will permit increases in crop yields in the future at the rates achieved in the past. Attention has been focused on an apparent slowdown in the rate of yield increases for some crops in some developed countries and on the apparent loss of momentum of the Green Revolution in developing countries.[9]

Between 1948-52 and 1966-70, the area sown to grains increased 35 percent in the developing countries (excluding Asian planned economies), but it remained steady in the developed countries (including the USSR and East Europe). Yet, the developed countries accounted for 61 percent of the gain in world grain production during the period because of rapid yield increases (fig. 12).

[9] Allen, George R., "Confusion in Fertilizers and the World Food Situation," *European Chemical News*, Oct. 1974.

Table 29—World cereal area, yield, and production, 1961 and 1972

Item	Area	Yield	Production
	mil. ha.	*metric tons/ha.*	*mil. tons*
1961:			
Developed	147	2.1	314
Developing	261	1.1	278
Centrally planned	256	1.3	332
World total	665	1.4	924
1972:			
Developed	146	3.1	452
Developing	290	1.3	367
Centrally planned	263	1.7	456
World total	698	1.8	1,275

Source: Food and Agricultural Organization.

In 1961, the developed countries produced 2.1 tons of cereals per hectare, while the developing countries produced just over 1 ton (table 29). By 1972, yields in developed countries had reached 3.1 tons per hectare and in developing countries, 1.3 tons. In North America, per hectare yields rose from 2.2 to 3.5 tons and in Western Europe, from 2.1 to 3.1 tons. Countries within these rapid-growth regions had even higher yield increases (table 30).

Table 30—Cereal yields, selected countries, 1961 and 1972

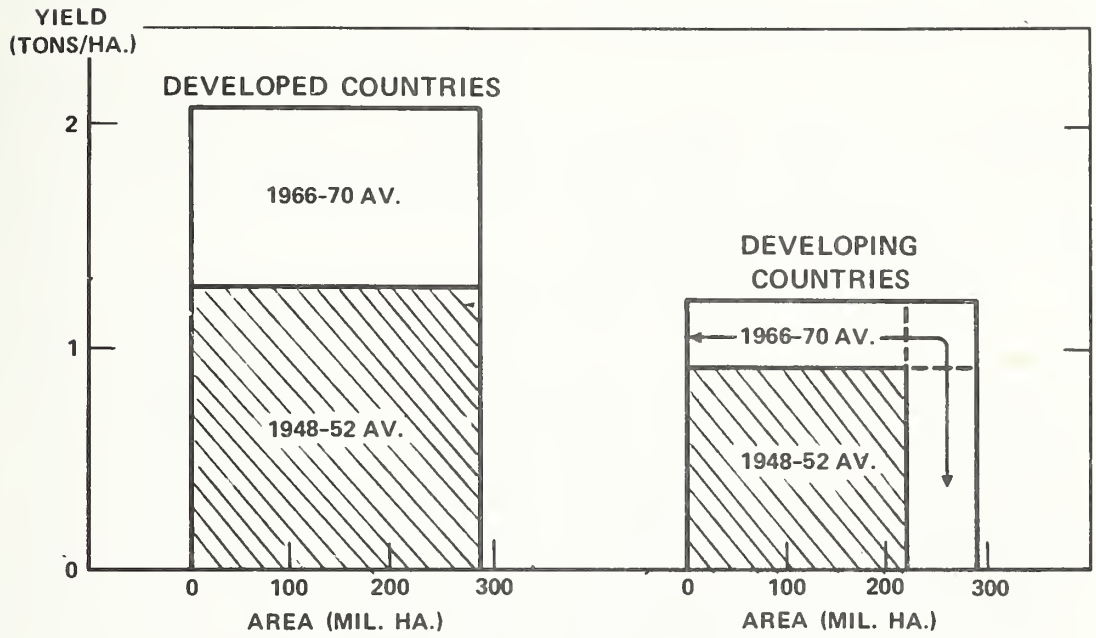
Country	1961	1972	Change
	metric tons/ha.		*percent*
Belgium	3.5	4.2	20
France	2.3	4.2	83
Germany, West	2.5	3.8	52
Italy	2.1	2.9	38
Sweden	2.8	3.5	25
United Kingdom	3.2	4.1	28
Japan	4.2	5.5	31
United States	2.5	3.9	56
Canada	1.3	2.0	54
Africa	0.8	1.0	25
Asia	1.3	1.6	23
Bangladesh	1.6	1.5	-7
PRC	1.4	1.8	29
India	0.9	1.1	22
Pakistan	.9	1.3	44
Philippines	1.0	1.2	20
Indonesia	1.5	2.1	40
Korea	2.9	3.4	17

Source: Data for wheat and coarse grains are from the Foreign Agricultural Service; data for rice are from the Food and Agriculture Organization.

The progress in Western Europe and North America was essentially a post-war phenomenon due primarily to greater use of fertilizer, improved seed varieties, and better cultivation practices. Prior to 1940, grain yields in most parts of the world were close to 1 ton per hectare.

An analysis of U.S. grain yields during 1950-74 for corn, wheat and grain sorghum shows that the yield trend has been strongly upward for each of the grains (table 31) In the 25-year period, wheat yields doubled and corn and grain sorghum yields about tripled.

ALL GRAINS: AREA, YIELD, AND PRODUCTION



In this chart the area of aach rectangla, datarmined as tha product of the amount of land in grains (in million hectares or the horizontal axis) times yiald per hactare (in kilograms on tha vertical scale), rapresents tha total production of grains in million tons for an indicated group of countries at a specified time. All four rectangles may be compared in height, in width, and in area.

1. Developed countries in 1966-70 accounted for:
   a. 50 percent of area in grains
   b. 65 percent of world grain production
   c. 61 percent of the increase in grain production over the 1948-52 average
   d. None of the increase in world grain area

2. From 1948-52 to 1966-70 the LDC's:
   a. Increased grain area 35 percent, reaching nearly 300 million hectares, thereby catching up with area in developed countries, which made no gain over this period.
   b. Increased grain yields 32 percent, to 1.2 tons per hectare, nearly equal to developed countries' 1948-52 yields which increased 63 percent by 1966-70.
   c. Increased grain production 78 percent to 356 million tons, nearly equal to the developed countries' 1948-52 production, which increased 64 percent by 1966-70.

   The increase in production in the developing countries was 156 million tons:

   45 percent from increased area
   41 percent from increased yields
   14 percent from combined effect of increased area and yields.

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FIGURE 12

Table 31—U.S. grain yields, 1950-74

Grain	1950-54 average	1955-59 average	1960-64 average	1965-69 average	1970-74 average
			metric tons per hectare		
Wheat	1.16	1.49	1.70	1.85	2.11
Corn	2.47	3.06	3.92	4.93	5.31
Grain sorghum	1.22	1.77	2.68	3.32	3.39
Barley	1.50	1.59	1.82	2.26	2.27
Oats	1.22	1.39	1.57	1.81	1.80
	1970	1971	1972	1973	1974[1]
Wheat	2.08	2.28	2.20	2.14	1.87
Corn	4.54	5.53	6.08	5.74	4.65
Grain sorghum	3.16	3.37	3.81	3.69	2.92
Barley	2.30	2.46	2.35	2.17	2.05
Oats	1.76	2.01	1.83	1.69	1.71

[1] Preliminary.

Source: Statistical Reporting Service, *Agricultural Statistics.*

There is no sound reason to believe that similar production increases are not possible in the developing world. Where new seeds, fertilizer, and improved techniques have been used in developing countries, dramatic yield increases have taken place.

In 1972, average grain yields in developing countries were only 42 percent of those in developed countries, compared with 52 percent in 1961. While developing countries increased yields by 200 kilograms per hectare over the period, the increase in the developed countries was 1 ton (1,000 kg). This worsening of the "yield gap" should not be seen as an inevitable process which cannot be changed. It reflects the slow rate of transformation of traditional to modern agriculture, a process which can be accelerated with better policies and more production-oriented assistance.

The Green Revolution

The Green Revolution refers to the adoption of high-yielding varieties of grain—especially wheat and rice—and an associated package of inputs. The varieties usually have short, stiff stalks, are highly fertilizer responsive, and are relatively photoperiod insensitive (are flexible as to planting date and may mature earlier). They are continually being improved through breeding, particularly to incorporate factors which will lead to yield stability. The package of inputs nearly always includes fertilizer and improved management, and usually includes insecticides, pesticides, and water control. Hence, the Green Revolution is not a single technique or event but a combination of techniques which are continually being modified.

The Green Revolution originated in Mexico in the mid-1940's. The first improved wheat varieties were released in 1948 and were followed by a constant stream of new varieties. Within 5 years, new varieties had been planted on 50 percent of Mexico's wheat land and within 12 years, on 90 percent. Yields had doubled by 1958 and doubled again following the introduction of the new semidwarf wheats in the early 1960's.

Hybrid corn was introduced in the United States in the early 1930's. It spread rapidly within a few years through the central Corn Belt, with adoption in Iowa virtually complete by 1940.[10] The adoption pattern followed a similar course in successive waves in surrounding States and then spread to southern States during the 1940's and 1950's. The immediate yield increases were impressive, but they were followed by successive, strong advances that continued through the 1950's and the 1960's, as well as into the most recent years. For both the hybrid corn in the United States

[10] Zvi Griliches, "Hybrid Corn: An Exploration in the Economics of Technological Change," *Econometrica*, Oct. 1957.

and the new wheats in Mexico, yield increases were not exhausted in the first few years after adoption, but continued as the farmers and the seed breeders learned to exploit the potentialities and as more inputs became available.

Outside of Mexico, high-yielding varieties (HYV) of wheat and rice were introduced in the mid-1960's and were adopted rapidly in selected areas (fig. 13). By 1972/73, the HYV wheat area in Asia and North Africa totaled about 17 million hectares, and the rice area was approximately 16 million hectares. In Latin America, nearly a half-million hectares of HYV rices were planted.

While HYV area in Asian developing nations has been assuming significant proportions (roughly 35 percent of the wheat area and 30 percent of the rice area excluding the centrally planned economies), in other areas of the world (aside from Mexico) it has remained relatively small. The Green Revolution has thus been highly concentrated in Asia, and within Asia it has been very heavily concentrated in a few countries. In 1972/73, India and West Pakistan together accounted for nearly 81 percent of the total HYV wheat area in Asia. The rice area was not concentrated to quite the same degree: India, the Philippines, Indonesia, and Bangladesh accounted for about 83 percent of the total. India alone represented 61 percent of the wheat area and 55 percent of the rice area.

Within these countries, the regional distribution of the HYV's was not even. In India, 48 percent of the HYV wheats were concentrated in two states, and 40 percent of the HYV rice varieties were concentrated in two other states. The uneven distribution was more pronounced in Pakistan: 74 percent of the HYV wheat was located in one province and 77 percent of the rice in another. While areas of concentration in South Asia correspond to the location of overall wheat or rice production to some extent, they are also tied to the availability of irrigation.

The Green Revolution has not, therefore, been a solution to the food-deficit problem in the tropics, nor has it failed because shortages have reemerged. Only a few years have elapsed since the HYV's were first disseminated in Asia, and just as it took from one to two decades for hybrid corn in the United States and HYV wheat in Mexico to achieve full adoption and high sustained yields, it will take time in Asia.

Life Cycles of Agricultural Technology

Most agricultural technologies must embody certain common features if they are to be adopted. And if adopted, they follow a fairly predictable life cycle. To be adopted initially, a technology usually has to show potential for increasing farm profits by lowering production costs per unit. Under market conditions, cost-reducing innovations normally result in expanded output. The usual adoption rate of a technology follows an S-shaped curve (fig. 14). At first the innovation is tried by a few operators, then the rate of adoption increases, and finally tapers off as the technology becomes fully adopted or is adopted as far as existing circumstances permit. Progressive regions go through the process more quickly than poorer regions. This pattern is reflected in the adoption pattern for hybrid corn in the United States (fig. 15).

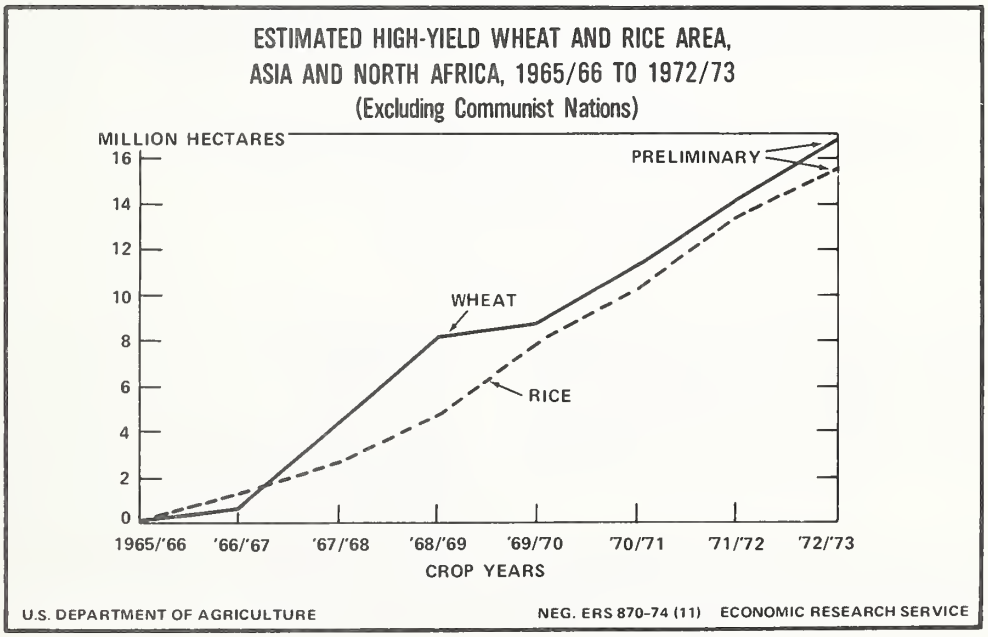


Figure 13

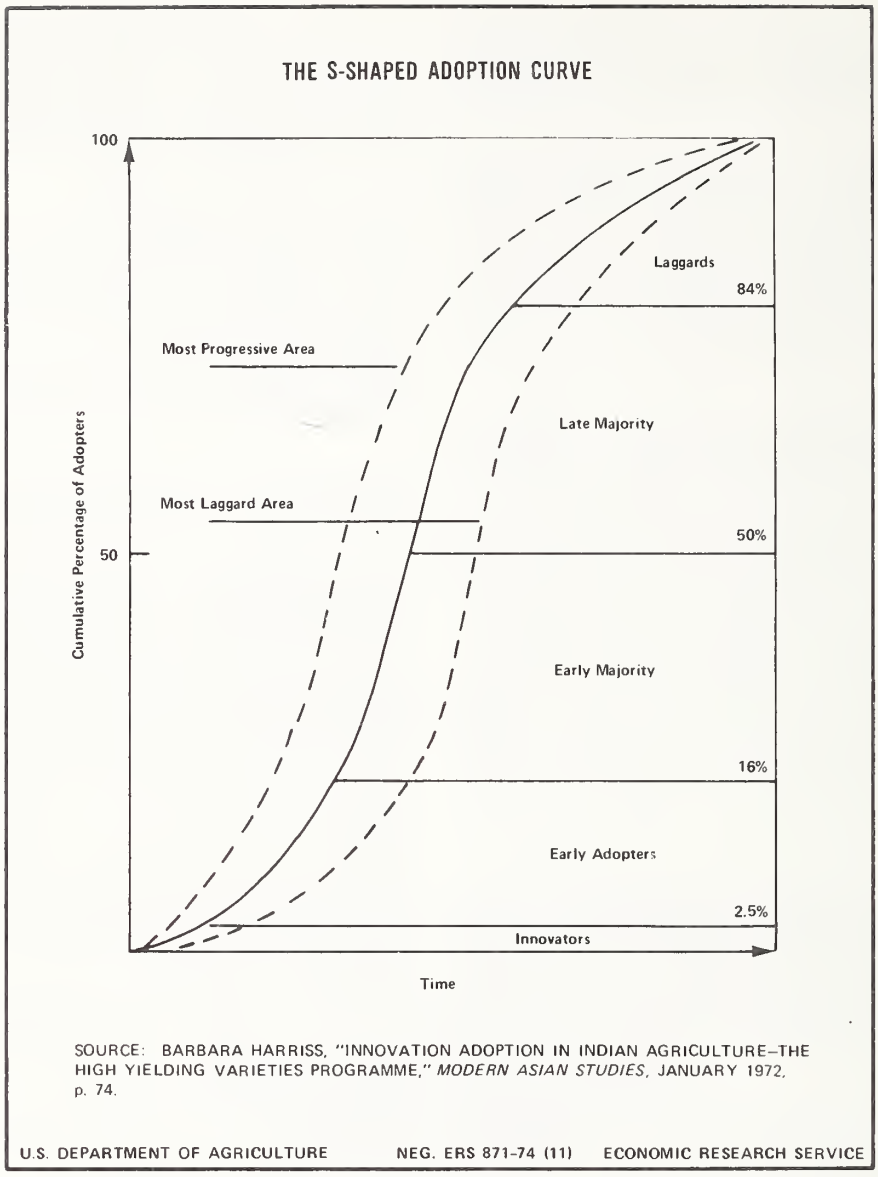


Figure 14

The first adopters, in return for the risks they take, usually reap the greatest returns. As more and more farmers adopt the practice and output expands, product prices decline. The final group of farmers to take up the practice may not realize as much profit but may have to adopt it just to keep their costs in line with other farmers.

The process is not "equitable" to producers—not everyone who adopts the practice gets the same return. Income disparities among producers may even be widened. Consumers, however, generally benefit through added supplies at lower prices.

Are the High-Yielding Seeds Following the Same Pattern?

The increase in area planted to the HYV's suggests a very rapid rate of adoption in certain Asian nations. In some of the most advanced areas, such as Pakistan's Punjab, farmers were quicker to adopt the new wheat seed and less conservative in using it than were Iowa farmers in adopting hybrid corn in the 1930's and 1940's. No country has reached 100-percent adoption for several reasons:

(1) Farm size, credit availability, and tenure have stopped some farmers;

(2) Uncertainty and risk, both economic and agronomic, have stopped others;

(3) Agro-climatic factors may not favor adoption in some areas since water control and temperature are crucial.

Associated Inputs

The HYV seeds are only one component of the Green Revolution. The other major ingredients are (1) improved water control, (2) increased use of farm chemicals for fertilization and plant protection, and (3) improved management practices such as seedbed preparation, seeding rates, weed control, and timing of fertilizer applications. But many farmers, even if they fully adopt the HYV's, fail to adopt all of the recommended package of inputs or practices. By 1969, for example, only 12 percent of the HYV farmers in India were fully following recommendations and much the same was true in the Philippines. As a result, yield increases were small.

Many of the same factors which retard the adoption of the seeds also retard the adoption of the associated inputs. The main difference is that the other inputs often cost much more. Fertilizer is a particularly significant cost factor. Many farmers have settled for a modified input package—one with a rather low investment in fertilizer. This provides some yield increase but does not expose the farmers to high risks. For a variety of reasons, the recommended levels may not be economic. Also, the needed inputs may simply not be available in the right form at the right time. If any one of the inputs is lacking, the potential offered by the high-yielding varieties may not be realized. Thus, factors relating to input costs and availability may be limiting the Green Revolution's potential. It is this which has produced the recent anxiety about the impact of fertilizer shortages and high fertilizer prices on developing country food production.

Seed Multiplication and Distribution

At this point in the Green Revolution, there is a tendency to take seed for granted. But the new seeds must constantly be replaced with newer seeds and much of this work must be done in the country and even regions where they are used. Most developing countries, however, do not have a highly advanced seed industry. FAO has recently suggested that the lack of a commercial supply of high-quality improved seeds has been one of the main bottlenecks limiting the rapid and sustained spread of the HYV's.

This may not matter so much at first, when areas are limited and reliance can be placed on imported seed. But within a few years and as area planted expands, seed must usually come from domestic sources. If the Green Revolution is to be maintained or expanded in the future, much more seed breeding and better quality seed distribution is needed in developing countries.

Irrigation and Water Control

The value of irrigation as an input for increasing production has become increasingly important with the advent of the Green Revolution. In many areas, irrigation is both a crucial input and a prerequisite for improved production.

To gauge both the impact of future droughts on production and the possibilities for future agricultural progress, it is useful to examine which countries have the most irrigation (table 32) and which countries are most intensively irrigated (table 33). The top five countries in terms of irrigated area—the People's Republic of China (PRC), India, the United States, Pakistan, and the USSR—have over 70 percent of the world's irrigated area, with the PRC alone accounting for almost 40 percent.

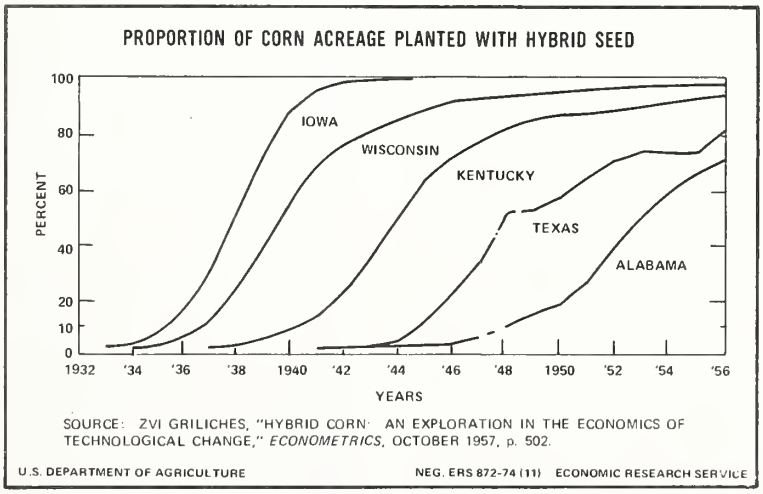


Figure 15

Table 32–Major irrigating countries, according to amount of irrigated area[1]

Country	Year[2]	Cultivated area[3]	Irrigated area	Percentage irrigated
		1,000 hectares		*Percent*
China (PRC)	1967 (1960)	110,300	75,980	68.9
India	1968	164,610	27,520	16.7
United States	1969	192,318	15,832	8.2
Pakistan	1969	19,235	12,505	65.0
USSR	1970	232,809	11,100	4.8
Indonesia	1969	18,000	6,800	37.8
Iran	1971	16,727	5,251	31.4
Mexico	1960 (1964)	23,817	4,200	17.6
Iraq	1970 (1963)	10,163	3,675	36.2
Egypt	1971	2,852	2,852	100.0
Japan	1970	5,510	2,836	51.5
Italy	1971 (1960)	12,409	2,444	19.7
Spain	1970	20,626	2,435	11.8
Thailand	1965 (1969)	11,415	1,830	16.0
Argentina	1968 (1959)	26,028	1,555	6.0
Turkey	1970 (1967)	27,378	1,549	5.7
Australia	1969	44,610	1,476	3.3
Chile	1965 (1964)	4,632	1,091	23.6
Peru	1971	2,979	1,116	37.5
Bulgaria	1971	4,516	1,021	22.6
Total[4]		1,457,000	203,600	14.0

[1] Includes individual countries having irrigated areas exceeding 1 million hectares. [2] Year refers to year for which data on cultivated area apply; year in parentheses refers to year for irrigation data when different from year for cultivated area. [3] Cultivated area is arable land plus land under permanent crops. [4] Total and numerical values should be regarded as approximate because of incomparability of data between countries and different years of data collection.

Source: FAO, *Production Yearbook*, 1971, and earlier years.

In judging a country's agricultural productivity and ability to withstand drought, however, the degree of irrigation coverage may be more important than total area irrigated. Taiwan, Egypt, the PRC, Japan, and Pakistan are the top five countries in percentage of land irrigated. Rice is a major irrigated crop in Japan and Taiwan, and these countries have, respectively, the first and third highest rice yields in Asia. South Korea, with nearly 80 percent of its rice land irrigated, ranks second in yields. Egypt's yields for premium cotton are among the highest in the world. Israel has invested heavily in irrigation and has become an important exporter of high-value crops such as fruits and winter vegetables, and has also developed some of the most advanced irrigation technology in the world.

The PRC ranks first in area irrigated and second in the share of cultivated area irrigated, according to FAO data. In contrast to the PRC, India—which is second in irrigated area—ranks twenty-third in proportion of the crop area irrigated. Indian yields for rice, a principal irrigated crop in both countries, are only slightly over half of Chinese yields. India does have several very heavily irrigated states, such as the Punjab, and in years of drought these regions supply much of the food needed in the drought areas.

But a vital issue, one often neglected in irrigation development in the developing countries, is the need for good control over the time-quantity distribution of water received during the season, or at least a predictable and certain water supply matched to crop requirements. This issue is as much a matter of the institutions developed for operation and administration of the systems as it is of the engineering for construction and design.[11]

Underutilization of new irrigation facilities by farmers is a common problem in developing countries. This underutilization has been attributed to various causes—including tradition-bound peasants, other social and cultural factors, scarcity of local investment resources, and lack of cooperation—but the timing of

[11] See, for example, Richard B. Reidinger, "Institutional Rationing of Canal Water in North India: Conflict between Traditional Patterns and Modern Needs," *Economic Development and Cultural Change*, Oct. 1974.

Table 33—Twenty-five major irrigating countries, according to percentage of area irrigated[1]

Country	Year[2]	Cultivated area[3]	Irrigated area	Percentage irrigated
		1,000 hectares		*Percent*
Egypt	1970	2,852	2,852	100.0
China	1967 (1960)	110,300	75,980	68.9
Pakistan	1969	19,235	12,505	65.0
Taiwan	1969	867	500	57.7
Japan	1970	5,510	2,836	51.5
Israel	1971	417	173	41.5
Albania	1967	556	227	40.8
Indonesia	1969	18,000	6,800	37.8
Peru	1971	2,979	1,116	37.5
Iraq	1970 (1963)	10,163	3,675	36.2
Korea, Rep. of	1969 (1968)	2,311	759	32.8
Iran	1971	16,727	5,251	31.4
Cyprus	1968 (1967)	432	102	23.6
Chile	1965 (1964)	4,632	1,091	23.6
Ceylon	1970	1,979	465	23.5
Bulgaria	1971	4,516	1,021	22.6
Madagascar	1966	2,900	620	21.4
Italy	1971 (1960)	12,409	2,444	19.4
Greece	1968 (1969)	3,631	711	19.6
Viet Nam, Rep. of	1971	3,065	580	18.9
Mexico	1960 (1964)	23,817	4,200	17.6
Somalia	1960	957	165	17.2
India	1968	164,610	27,520	16.7
Saudia Arabia	1967	809	131	16.2
Thailand	1965 (1969)	11,415	1,830	16.0

[1] Includes only countries with more than 100,000 hectares of irrigated area. [2] Year refers to year for which data on cultivated area apply; year in parentheses refers to year for irrigation data when different from year for cultivated area. [3] Cultivated area is arable land plus land under permanent crops.

Source: FAO, *Production Yearbook*, 1972, and earlier years.

water availability and its quantity in relation to its value have generally been neglected.

Much of the rapid spread of small, private tubewells in northern India and Pakistan has often occurred in areas already well-served by canals, and before the advent of effective government programs for tubewell development. This suggests that many farmers are willing and able to invest heavily in a water supply which they can control to match their water needs. Much of the tubewell investment has occurred simultaneously with the new high-yielding varieties which respond strongly in the presence of adequately controlled water supplies.

Unfortunately, tubewells are not possible or feasible in areas where ground water is too saline or too deep, or where geological conditions do not permit development of wells having economic yields. Also, tubewells are costly, particularly for the individual smallholder and perhaps for the country as well. It is therefore imperative that irrigation projects be designed to provide individual farmers or groups of farmers with maximum water control.

The new high-yielding varieties of rice and wheat have a proven potential. Their use, however, does not automatically guarantee higher yields. Utilizing the high potential of the new varieties requires heavier application of inputs, and especially improved and more precise management of the crop and inputs, including the timing and amount of water application. The lack of water control leaves untapped much of the potential of the new varieties. Improvement of irrigation management to enable farmers to increase efficiency of water use and more fully utilize the potential of new technologies is becoming increasingly important.

Weather and Climate

The unusual weather patterns that have occurred during the past several years—persistent, widespread

droughts; heavy flooding; changes in the severity of winter weather; and shifts in monsoons—have given rise to concern that global shifts in climate are in progress. Although the effects of weather and climate on crops can be modified to some extent, most of the world's food supply still depends on the weather. Some regions—Oceania, Canada, and eastern portions of the USSR—experience quite wide fluctuations in production from year to year. Other regions—Europe, the United States, much of Latin America, Africa, and Asia—experience generally consistent weather patterns, with serious droughts or other adverse weather developing less frequently.

Changing Climate

Climate—the average of weather variables over a considerable period of years—is much more stable than the short-period fluctuations in the weather. Although relatively precise meteorological records date back only a century or so, evidence of broad, long-term climatic change has been obtained from descriptive historical records and natural phenomena, such as the width of tree rings, vegetative layers in peat bogs, pollen samples in lake sediments, glacial deposits, fossil remains of plants and animals, carbon dating, and core samples from ocean floors and the polar ice caps.

Is a Climatic Shift in Progress?

A number of recent scientific and popular articles suggest that the world is at the point of a major change in climate, that the "good" weather of the past half-century or so is giving way to a cooling trend. that the impact on agriculture could be disastrous, and that the effect on mankind (through reduced crop production) could be catastrophic.

Examples of recent weather aberrations are droughts in the southern Sahara, East Africa, Northwest India, and in the midwestern United States; torrential rains and floods in the midwestern United States and the Philippines; and unusually warm winters in the eastern United States and in European USSR. On a smaller scale, some parts of England and southern Sweden recently experienced the driest conditions in many decades.

Concern about climatological changes has focused on the gradual cooling of the Northern Hemisphere since the 1940's following a warming trend which began about 1880. Some observers believe that this could be the first sign of a new period of glaciation. Explanations for the cooling trend include sunspot activity, the effects of air pollution, and other factors. It is argued that in recent years, this cooling trend has caused disruptions in world wind patterns. and that these have blocked monsoons from extensive interior land areas. This phenomenon is given as one explanation for the persistence of drought in the Sahel and monsoon "failures" in India.

Major changes in global climate have occurred at intervals of roughly 100,000 years. Other changes have occurred at periods of about 20,000 years. Fluctuations of several thousand years and several hundred years have also been suggested.

Some meteorologists believe that the climate of the past five or six decades has been unusually favorable. If so, it may be argued that the weather in coming decades is likely to be less favorable, reducing crop yields and forcing changes in cropping patterns.

While the possibility of a major change in climate and the resultant catastrophic effects cause justifiable anxiety,[12] such forecasts have been questioned by other meteorologists. While most meteorologists agree that climatic change is not entirely random in nature, there is no general agreement that climatic change is predictable for decades ahead. Great strides have been made in understanding the weather, but much is still unknown or imperfectly understood. Changes in weather and climate occur as the result of an extremely complex interaction of forces—radiant energy of the sun, the tilt of the earth, differentials in heat absorption and retention between water and land surfaces, and changes in temperature, precipitation, and air movements resulting from the interaction of the atmosphere and the oceans. Quantification of these relationships is hindered by the lack of precise, long-term meteorological records. Within the perspective of recent historical records—the past century—current weather-climate abnormalities may well be only "normal" variations.

For example, the effects of single (11 year) and double (22 year) sunspot cycles are subject to question. The magnitude of any cooling effect of matter entering the atmosphere through man's activity is also in dispute. Volcanic ash and sulfur dioxide in the upper atmosphere appear to have a definite cooling effect, but increased carbon dioxide, the result of increased burning of fossil fuels, could exert a warming influence.

It has been hypothesized that a shifting and expanding circumpolar vortex is changing weather patterns, as in Africa and India, blocking monsoons, and prolonging droughts.[13] However, interpretations can be influenced by poor data, the period of time selected, and the season observed. Shifts in the vortex, if significant, should also show up in other seasons.

Evidence thus far presented regarding possible major climatic changes has been scrutinized by the

[12] "There is very important climatic change going on right now. And it's not merely something of academic interest. It is something that, if it continues, will affect the whole human occupation of the earth—like a billion people starving." Reid Bryson, Director, Institute for Environmental Studies, University of Wisconsin, *Fortune*, Feb. 1974.

[13] Tom Alexander, "Ominous Changes in the World's Weather," *Fortune*, Feb. 1974.

Interdepartmental Committee for Atmospheric Sciences. Its report concludes that "present day climate is much warmer than the average of the past several centuries," and suggests that "a return of the earth to cooler conditions is a realistic expectation over the long run." [14] But the committee states that "advance knowledge of long-term future changes of climate, of undoubted value to modern society, is not yet available."

Projections of future food production levels, including those in this study, generally rest on the assumption that "normal" weather can be expected to prevail. But policies and programs for expanding food production should recognize the possibility that weather conditions could be either less favorable or more favorable than normal. This underscores the need for flexible world food policies to adapt to changes in conditions and to provide a margin of security against sudden or unexpected changes.

Weather Effects are not Offsetting

For the world as a whole, there is a positive correlation between the effects of weather in one place and those in another. An analysis of yield trends and variations in 25 regions covering the world's major grain producing areas indicates that when grain yields decline because of adverse weather in one part of the world, the chances are better than even that they will be lower in many other parts of the world, too.[15] The correlation is not great, but poor years seem to be experienced in many of the world's grain regions at the same time. Similarly, good weather (as evidenced by yields) tends to be experienced at the same time. Generally poor weather conditions could help to explain the major declines in food production in 1964-66 and 1972 and 1974.

However, the analysis suggests that from year to year, the effects of weather are random. While some regions show patterns of persistently good or bad weather from year to year, others tend to oscillate. But on the average for the world, the probability of consecutive good or bad years is about 50-50.

The analysis of grain yield variation showed that the weather in one year out of three could be expected to produce a deviation greater than 21 million tons from trend production in the grain regions studied (table 34). If the influence of weather were entirely random, the expected deviation would be 14.7 million tons.

Table 34—Changes in grain production due to weather in 25 major world grain producing regions

Grain	Without covariation[1]	With covariation[2]	Percent difference
	million metric tons		
Wheat	11.59	13.28	+15
Rice	4.58	4.81	+5
Corn	5.68	6.24	+10
Barley	5.13	5.42	+6
Oats	1.95	2.23	+14
Sorghum-millet	2.06	2.23	+8
Rye	0.91	1.03	+13
Coarse grains (incl. rye)	8.22	10.04	+22
All grains (incl. rice)	14.74	21.08	+43

[1] Assumes that yield fluctuations are not related.
[2] Includes interrelation between yield fluctuations.

Source: Economic Research Service

Trends in Weather and Grain Yields

The analysis of the grain yields in the 25 world regions did not reveal the existence of weather cycles or trends. The period under investigation, 1950-73, is relatively short for determining with confidence the absence or presence of weather cycles—and thus the analysis does not prove that they do not exist. It may be simply that none were evident during these years. A series of exceptionally bad or good years is possible. There are series of years in nearly every region when yields are clustered above or below the trend, as illustrated in table 35 for the U.S. Great Plains. However, these clusters are not consistent among regions or over time. For example, both Great Plains regions experienced low wheat yields in the drought years of the early 1950's. But while wheat yields in the Southern Plains were below trend in every year from 1962 through 1968, they were near or above trend in all these years in the Northern Plains.

The yield analysis also casts light on the question of whether yield increases are slowing down. While the trends differ widely from region to region—and for Canada, the USSR, Australia, Argentina, and South Africa, the annual fluctuations are extremely large—there does not seem to be a general slowing down of yield increases in major world regions through 1973. In fact, a greater share of the yield series were above trend in 1970-73 than in any period since the first half of the 1950's.

[14] Report of the Ad Hoc Panel on the Present Interglacial, National Science Foundation, Aug. 1974.

[15] An effort was made to divide the world into homogeneous climatic regions. Sixty-six "data series" were used in the analysis. A data series represents an individual crop in a region, as for example, U.S. Northern Great Plains wheat. Obviously, there will be more than one crop series for many of the regions. The analysis covered the period 1953-73 and represented about two-thirds of total world grain production.

Table 35—Deviations from trend in wheat yields, U.S. Northern and Southern Plains, 1950-73

Year	Northern Plains			Southern Plains			Direction of deviation					
	Actual	Trend	Deviation	Actual	Trend	Deviation	N+	S+	N-	S-	N-	S+	N+	S-
	- - - quintals per hectare - - -													
1950	9.75	8.35	+1.40	9.55	9.27	+.28	X							
1951	10.02	8.85	+1.17	8.41	9.76	-1.35							X	
1952	7.60	9.35	-1.75	13.05	10.25	+2.80					X			
1953	8.61	9.85	-1.24	9.28	10.74	-1.46			X					
1954	8.07	10.35	-2.28	10.49	11.23	-.74			X					
1955	11.70	10.85	+.85	10.09	11.72	-1.63							X	
1956	11.43	11.35	+.08	10.56	12.21	-1.65							X	
1957	13.11	11.85	+1.26	12.78	12.69	+.09	X							
1958	16.00	12.35	+3.65	18.43	13.18	+5.25	X							
1959	10.83	12.85	-2.02	13.65	13.67	-.02			X					
1960	13.72	13.35	+.37	18.02	14.16	+3.86	X							
1961	9.62	13.85	-4.23	16.75	14.65	+2.10					X			
1962	16.68	14.35	+2.33	13.92	15.14	-1.22							X	
1963	14.53	14.85	-.32	13.65	15.63	-1.98			X					
1964	15.33	15.35	-.02	14.66	16.12	-1.46			X					
1965	16.61	15.85	+.76	15.67	16.61	-.94							X	
1966	15.80	16.35	-.55	14.80	17.10	-2.30			X					
1967	16.68	16.85	-.17	13.38	17.59	-4.19			X					
1968	18.49	17.36	+1.13	16.88	18.08	-1.20							X	
1969	18.76	17.86	+.90	19.30	18.57	+.73	X							
1970	16.21	18.36	-2.15	20.78	19.05	+1.73					X			
1971	20.65	18.86	+1.79	20.98	19.54	+1.44	X							
1972	19.30	19.36	-.06	20.18	20.03	+.15					X			
1973	18.96	19.86	-.90	22.26	20.52	+1.74					X			

9. FACTORS AFFECTING DEMAND FOR FOOD

Population growth, the major determinant of demand for food, is faster among the developing countries, where 70 percent of the world's people live. World population is growing at the rate of 70 million people a year, with the developing countries accounting for 86 percent of the annual increase.

As incomes rise, consumers buy more food, but a smaller proportion of that income is spent for food. Incomes are more unequally distributed in the developing countries. For some time, the developing countries will continue to be heavily dependent upon grains for their food. The developed countries will continue to consume less grain directly, and they will convert more grain to meat, milk, and eggs.

The demand for food depends primarily upon population and income growth. the level and distribution of income, and the proportion of income spent for food.

Population and Income Growth

Total world population reached an estimated 3.8 billion in 1973, a rise of 1 billion over 1957. The average annual growth rate has leveled off at a little under 2 percent in the past 15 years, following a substantial rise through the 1950's. The annual increase is now about 70 million people, nearly double what it was in 1950.

Of fundamental importance for food demand as well as many other aspects of economic development is the great difference in the rate of population growth between the developed and the developing economies. The developed market economies' population growth rate has declined to 0.9 percent annually, whereas the developing market economies are expanding at more than 2.5 percent. The developing countries now contain over 70 percent of the world's population, and they are accounting for 86 percent of the annual increase.

These trends and shifts in population are being accentuated with the passage of time. In 1960, the developing countries had about twice the population of the developed countries; by 1970, they had two and one-half times as much; and by 1985, they are projected to have three times as much. Within the developing countries, the growth rate in all regions continues to be high, so there is little redistribution between continents. South and Southeast Asia, with their very large and concentrated populations, have the greatest absolute increases, but West Asia, Africa, and Latin America all continue to grow rapidly.

During the 1960's, annual growth of gross national product (GNP) per capita averaged 3.9 percent in the developed market economies—not much different from the centrally planned economies—and 3.2 percent in the developing countries (table 36).

During 1970 and 1971, growth rates in the developed economies slowed, averaging only 2.5 percent per capita annually. But growth rates doubled during the next 2 years, as economic booms occurred throughout most of the developed world. In developing countries, economic growth also quickened in 1972 and 1973. Thus, even though the principal influence pushing food prices upward came from disruptions in supply, increased demand accentuated the price rise.

As a result of population and income growth, world demand for grains was increasing a little less than the rate of increase in world grain production for several years prior to 1972.

In the developed countries, the growth in demand was due primarily to the growth in incomes, and the use of grain was enhanced by relatively low prices during the latter part of the 1960's. While income growth generated rapid growth in demand for livestock products, and while the quantities of grain demanded were larger, there does not appear to have been an appreciable change in the pattern of grain consumption. The pre-1972 expansion in grain consumption in the developed countries took place during a period of surpluses and therefore did not draw grains from direct food use. Since 1972, however, competition between food and feed uses of grain has been

Table 36–Estimated average annual growth rates of developed and developing countries

Country	1950-1960	1960-1970	1960-1965	1965-1970	1968-1973	Change from preceding year				
						1969	1970	1971	1972	1973
					percent change in GNP per capita					
Developing countries, total		3.2	2.9	3.5	4.1	4.4	4.1	3.1	3.6	4.8
Africa		2.2	1.3	3.0	3.8	4.3	5.2	2.2	4.1	2.5
Asia		3.3	2.7	3.9	3.9	4.6	3.6	3.2	2.6	5.6
East Asia		3.8	2.7	4.8	5.1	5.4	4.7	4.1	3.3	7.5
Near East	4.0	4.3	4.1	4.5	6.0	5.0	4.8	6.8	6.7	5.8
South Asia	1.8	1.9	1.4	2.4	0.9	3.4	1.4	-0.8	-2.8	3.4
Latin America	2.3	2.8	2.6	3.0	3.9	3.8	4.2	3.2	4.0	4.3
Developed countries, total	3.1	3.9	4.1	3.7	3.9	4.4	2.3	2.7	4.6	5.5
Excluding U.S.	4.2	4.7	4.6	5.1	4.9	6.5	5.1	3.1	4.1	5.7
United States	1.4	2.7	3.3	2.1	2.6	1.7	-1.5	2.1	5.2	5.1
Europe	4.3	4.0	4.0	4.1	4.2	5.7	4.6	2.6	3.2	4.9
Japan	7.1	10.1	9.1	11.1	8.4	10.8	9.1	4.9	7.9	9.2

Source: Agency for International Development, *Gross National Product,* RC-W-138, May 1, 1974.

apparent as has competition between the world's rich and poor for all foods. [1]

In the developing countries, population growth is the major factor explaining increasing demand for grain, and the demand for grain is principally for direct consumption. Throughout the developing countries the income elasticity of demand for grains is substantial, ranging from .3 to .5 in most areas. Thus, higher incomes have added additional strength to the vigorous expansion in demand for grains in developing countries that results from rapid population growth.

In 1974, economic growth rates in most developed countries slowed sharply. This slowdown can be expected to adversely affect growth in the developing countries. These developments, although not desirable, can be expected to reduce some of the demand pressures which were so strong during 1972-73. Higher food and feed prices will also work to reduce consumption. This development, if accompanied by an improvement in supply in 1975, should greatly reduce the competition for food supplies that has been evident over the past 2 years.

The Proportion of Income Spent for Food

As incomes increase, a smaller proportion is spent for food. In most low-income countries half or more of income is spent for food, whereas the proportion drops to less than one-fifth in the highest income countries. The income-food expenditures relationship reflects a hierarchy of preferences ranging from the least to the most desired foods. This relationship is usually measured by income elasticities which express the ratio of the percentage increase in consumption of a given food to a percentage change in income. Income elasticities are lowest for roots and tubers, a little higher for coarse grains for human consumption, and progressively higher for other cereals, pulses, fruits and vegetables, and animal products (table 37).

For high-income consumers, cereals make up a low proportion of the food budget and income elasticities for direct consumption of grains are low. However, income elasticities for livestock products (and therefore the indirect consumption of coarse grains) are relatively high. Low-income consumers spend a higher proportion of their budget for direct cereal consumption and have higher income elasticities, especially for food grains. Thus, the quantity of food grains demanded by low-income consumers is affected only slightly by price changes.

Income Distribution

Not only are there great differences in average incomes per capita between developed countries and developing countries, there are also important differences in the way incomes are distributed within countries.

A study of income distribution in 56 countries indicates that income distribution is more unequal in developing countries than in developed countries, and income inequality tends to increase during the early stages of the process of economic development.[2]

[1] If consumers of grain begin to use larger quantities at the same levels of income and grain prices, then a shift in the pattern of grain demand has taken place. But when incomes increase and grain prices decrease, the predictable result is that the quantity of grain demanded will increase. The increased consumption of grain during 1967-72 was not, therefore, an unprecedented shift in demand, but was due to an unexpected combination of price and income effects. While this increase may not have been expected, it was not unpredictable, and it was consistent with the changes in incomes and prices that took place.

[2] Felix Paukert, "Income Distribution at Different Levels of Development: A Survey of Evidence," *International Labour Review*, Vol. 108, Nos. 2-3, Aug.-Sept. 1973.

Table 37—Representative income elasticities for selected foods

Food	India	Brazil	Japan	Australia	EC	U.S.	World
Wheat	.50	.40	.10	-.10	-.32	-.30	-.24
Rice	.40	.20	-.10	.00	.11	.20	.23
Maize	-.10	-.30	[1]-.50	.00	-.12	-.10	.10
Sugar	1.03	.09	.39	-.10	.31	.10	.29
Fruits	.80	.49	.57	.71	.58	.25	.55
Meat	1.17	.48	.79	.07	.48	.24	.32
Fats & oils	.92	.68	.40	.05	.13	.01	.22
Total food	.43	.19	.13	.02	.08	-.01	.10
Farm value	.57	.34	.28	.11	.25	.04	.19

[1] Coarse grains.

Source: FAO, *Agricultural Commodity Projections, 1970-1980*, Vol. II, 1971, Rome.

Incomes in countries with $100 to $200 per capita are more unequally distributed than are incomes in countries with $100 or less. Countries in the next income group, $200 to $300 per capita, have the most unequal income distribution of all. As average incomes rise beyond $300, there is first a slow improvement in equality, and then a more pronounced improvement for the higher income countries—those with $1,000 to $2,000 per capita. Countries with $2,000 and over per capita have the least unequal income distribution of any of the groups (table 38).

Thus, in the early stages of development, there may be an increase in the inequality of incomes, which is typically reversed with a movement toward more equal distribution as countries reach high income levels. The most striking shift in income distribution is in the proportion of total income received by the top 5 percent of income receivers (fig. 16). Where per capita income is under $500, the top 5 percent receive around 30 percent of the total income. This proportion declines to 16 percent in the higher income countries. However, for the lowest fifth of income receivers, the proportion of total income received is at least as large in the poor countries as in the rich ones. For the 3rd and 4th quintile, the proportion of income is appreciably higher for the richer nations.

The proportion of income spent for food at different income levels and the changes in income distribution over time are important to the demand for food in two important respects. The World Bank has used an average of $200 per capita GNP to designate low-income countries, and has pointed out that two-thirds of the world's population—about 2 billion people—live in such countries. While their incomes are expected to increase, this will not make a substantial change in their average per capita incomes in a decade. Thus, the character of their demand for food cannot be expected to change very much—they will continue to be heavily dependent on grains, tubers, and root crops. Furthermore, since a large proportion of these 2 billion people have incomes substantially below the $200 average level, and the proportion of people in this group may rise before incomes become more evenly distributed, the demand for food will be strongly influenced by the demands of the lower income groups, and this demand will be largely for grain for direct consumption. In this sense, the food situation for a large part of the world's population will continue to be a problem of grain—its availability and price.

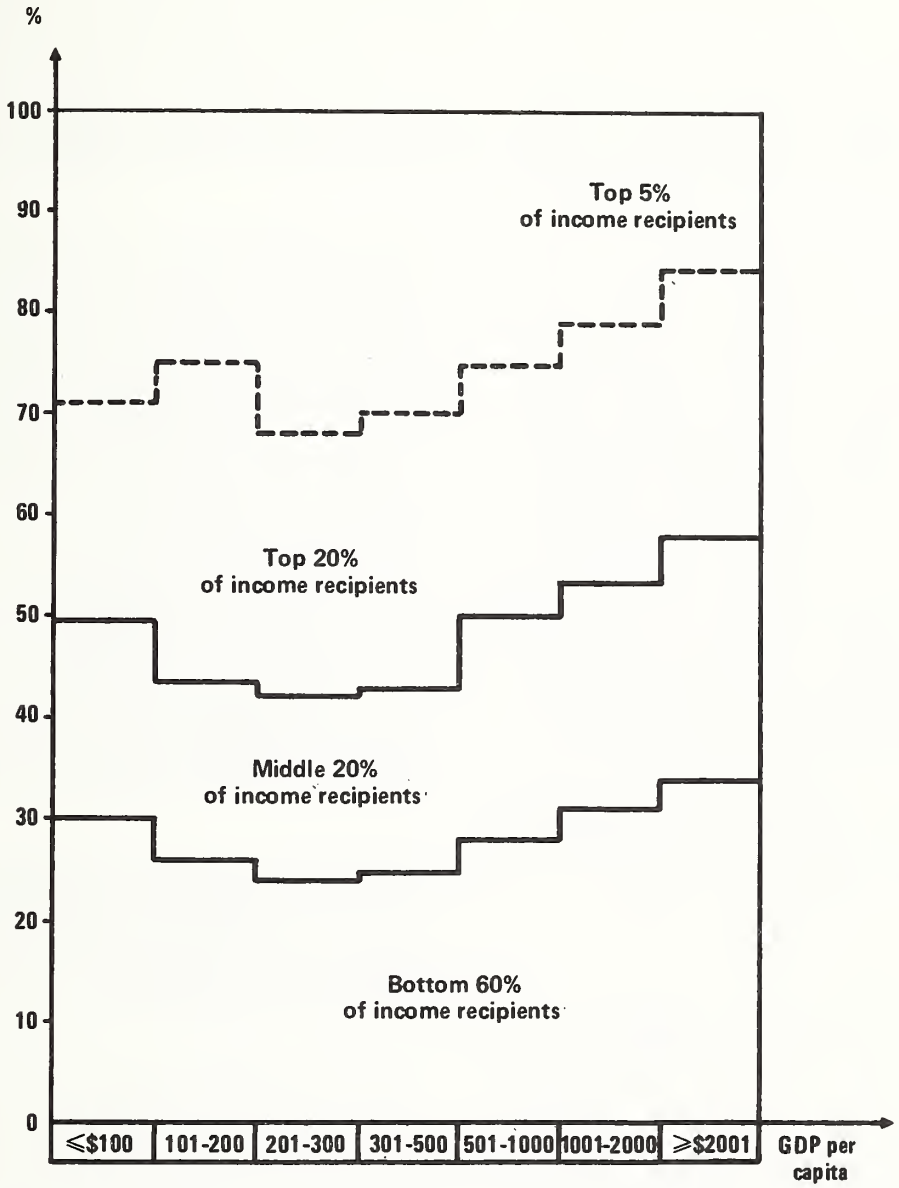
Table 38—Indicators of size distribution of income (average for groups of countries)

GDP per head (US$)	Number of countries	Quintiles					Top 5%	Bottom 40%	Bottom 60%
		1st (lowest)	2nd	3rd	4th	5th (highest)			
		- - - - percent - - - -							
Below 100	9	7.0	10.0	13.1	19.4	50.5	29.1	17.0	30.1
101-200	8	5.3	8.6	12.0	17.5	56.5	24.9	13.9	25.9
201-300	11	4.8	8.0	11.3	18.1	57.7	32.0	12.8	24.1
301-500	9	4.5	7.9	12.3	18.0	57.4	30.0	12.4	24.7
501-1,000	6	5.1	8.9	13.9	22.1	50.1	25.4	14.0	27.9
1,001-2,000	10	4.7	10.5	15.9	22.2	46.6	20.9	15.2	31.1
2,001 and above	3	5.0	10.9	17.9	24.1	42.7	16.4	15.9	33.8

Note: First quintile represents the percentage of total personal income received by the poorest 20 percent of income recipients, the second quintile represents that received by the next 20 percent.

Source: Felix Paukert, "Income Distribution at Different Levels of Development: A Survey of Evidence," *International Labour Review*, Vol. 108, Nos. 2-3, Aug.-Sept. 1973, p. 118.

DISTRIBUTION OF INCOME AT DIFFERENT LEVELS OF PER CAPITA GDP



SOURCE: FELIX PAUKERT, "INCOME DISTRIBUTION AT DIFFERENT LEVELS OF DEVELOPMENT: A SURVEY OF EVIDENCE," *INTERNATIONAL LABOUR REVIEW,* VOL. 108, NOS. 2-3, AUG.-SEPT. 1973, p. 119.

Figure 16

10. DIVERSITY AMONG DEVELOPING COUNTRIES

The great diversity among the developing countries dictates a wide range of solutions to the world food gap. Some of the least developed countries are very poor. A few, such as oil-rich Kuwait and Saudi Arabia—are wealthy. They and other OPEC countries are uniquely able to pay for cereal grain imports. Some developing countries are self-sufficient in food and a few—Argentina and Thailand, for instance—are net exporters of grain.

The developing countries can be grouped roughly into four categories: (1) those with unexploited potential for increased food production (2) those with serious production constraints, (3) those that regularly produce food surpluses, and (4) those that produce less than enough food for themselves but who can pay for food imports.

Many of the developing countries are being hard hit by higher oil prices, inflation, reduced world stocks of grain, high prices for imported cereals, and increased ocean shipping rates and high prices for fertilizer.

The aggregation of a large number of countries into the general category of "developing" tends to obscure the nature of the food problems confronting individual countries or groups of countries. At one end of the spectrum are such countries as Upper Volta and Haiti, designated by the United Nations as among the world's "least developed," [1] and therefore poorest, countries. At the other end of the spectrum are oil-rich countries such as Kuwait and Saudi Arabia.

Of particular concern are those countries hardest hit by higher oil and food grain prices. These countries comprise the Overseas Development Council's 40 "poorest" or most severely affected countries.[2]

Many developing countries are largely self-sufficient in food, as indicated by net exports of grains. Among the 40 poorest countries, Kenya, Burma, Khmer Republic, Malagasy Republic, Niger, and Malawi are normally net exporters of food grains.[3]

Other developing countries not listed among either the 25 least developed or the 40 poorest are also normally net exporters of food grains; they include Uruguay, Guyana, Argentina, Angola, Rhodesia, Mexico, and Thailand. The fact that a country is a net exporter of cereals does not necessarily indicate the absence of a food problem. It could hardly be said that Niger, one of six West African countries hit hardest by drought and famine, and which has received substantial cereal imports over the past 2 years, does not have a food problem.

Of the developing countries that are net food importers,[4] the OPEC [5] countries are in a unique position. Some of the OPEC countries are among the richest in the world. These countries have the financial capability to pay for food imports. Even Indonesia, among the poorest of the oil-exporting countries with a per capita income of $80, should be less hampered by the cost of food imports, although there are good possibilities for Indonesia to increase food production.

Among the factors likely to pose serious short-run problems for many developing countries are increased costs of oil and petroleum products, worldwide inflation, reduced stocks of grains, high prices for imported cereals, increased freight rates, and shortages and high prices for fertilizer.

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[1] The U.N.'s least developed countries include: Afghanistan, Bhutan, Botswana, Burundi, Chad, Dahomey, Ethiopia, Guinea, Haiti, Laos, Lesotho, Malawi, Rep. of Maldives, Mali, Nepal, Niger, Rwanda, Sikkim, Somalia, Sudan, Tanzania, Uganda, Upper Volta, Western Samoa, and Yemen.

[2] In addition to the 25 least developed, the ODC's 40 poorest include: Bangladesh, Burma, Central African Republic, Gambia, India, Kenya, Khmer Republic, Malagasy Republic, Mauritania, Pakistan, Sri Lanka, Swaziland, Togo, Yemen Democratic Republic, and Zaire. A United Nations' list of most severely affected countries also includes Cameroon, El Salvador, Ghana, Guyana, Honduras, Ivory Coast, Senegal, and Sierra Leone.

[3] Calculated on the basis of net cereal imports as a percentage of domestic supply, 1966-70. FAO, *Preliminary Assessment of the World Food Situation, op. cit.*, pp. 33-34.

[4] FAO, *Trade Yearbook, 1972*, Rome 1973.

[5] The OPEC countries (Organization of Petroleum Exporting Countries) include: Abu Dhabi, Algeria, Ecuador, Gabon, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, and Venezuela.

Increased costs for oil, raw materials, and manufactured goods may severely deplete the foreign exchange reserves of many non-oil producing developing countries. Estimates of the impact of oil import costs for the developing countries vary. According to OECD estimates, the 1974 increase in oil import costs could be as high as $8.5 billion.[6] Another estimate puts the additional cost at $7.8 to $9.8 billion in 1974.[7] Because of the diversion of scarce funds from investments, high energy and food prices may have an unfavorable impact on the long-run agricultural prospects of the developing countries.

In the medium-term, the energy crisis can be expected to depress economic growth rates in non-oil producing developing countries and increase them in the oil-exporting countries. Many developing countries, however, are not high users of energy, especially in agriculture. The most important impact, therefore, is likely to be on their ability to pay for food imports; in many instances, hard choices will have to be made between oil, food, and other essential imports.

The current shortage and high prices for both nitrogenous and phosphatic fertilizers is perhaps the most serious near-term problem facing those developing countries that have adopted or intended to expand Green Revolution technology. A reduction in the use of fertilizers or a slowdown in the rate of increase in fertilizer use, particularly in some South Asian countries where high-yielding varieties of wheat and rice have been introduced, could result in serious production shortfalls or in a slower rate of food production growth.

While self-sufficiency in food production is often considered a desirable goal in developing countries, it needs to be examined more critically. In many of the developing countries, comparative advantage in production lies in exploiting natural resources other than agricultural land. This group includes the oil-rich, Mideast countries and other countries with high-value export commodities—petroleum or other raw materials. Also, others have a comparative advantage in producing nonfood crops.

The great diversity of developing countries suggests that the food gap problem needs to be broken down into parts. In particular, programs designed to be helpful in expanding food production will have to be related to the specific problems and the resources of the countries involved. The following groups of countries can be distinguished.

[6] OECD, "Impact of Recent Trends in Oil and Commodity Prices on Developing Countries," Aug. 1974.

[7] Bureau of Program Policy Coordination, U.S. Agency for International Development, "The Energy Crisis and the LDC's," The Problem and Alternatives for Action. Feb. 1974.

1. Countries With Unexploited Potential

a. *Those where the Green Revolution is underway*

The countries which have adopted the essential elements of the new technology called the Green Revolution have as yet obtained only a fraction of the potential this technology offers. India, Indonesia, Pakistan, the Philippines, and other countries in South and Southeast Asia have made definite progress with the Green Revolution. Turkey, as well as Morocco, Tunisia, and Algeria, have also introduced the high-yielding wheat varieties.

But in each case, the principal progress has occurred in areas with good water control and even in these areas, the majority of farmers are getting very little of the potential yield increase. All of these countries are experiencing heavy population pressures and have limited additional arable land. The need in these countries is for programs to help break the bottlenecks which are limiting yield increases. Although the relative significance of each varies from country to country, the major bottlenecks are:

- Lack of adequate water control;
- Lack of suitability of the new seeds to the actual farming conditions existing in much of the country;
- Lack of adequate in-country research and seed reproduction;
- Inadequate supply of the necessary combination of inputs;
- Inability (or lack of incentives for farmers) to adopt the full combination of necessary technology.

The real benefits of the Green Revolution were achieved by Mexico only after several years had elapsed and came about through constant development of new, modified varieties developed in the country itself. This was also true of hybrid corn in the United States. Had either of these developments halted in their first 10 years, the contribution of the new varieties to production increases would have been marginal.

At the International Rice Research Institute (IRRI) in the Philippines, consideration has been given to how to bridge the gap between the average yield of 1.5 tons per hectare for all rice land in the Philippines and the 6 to 8 tons per hectare obtained on IRRI research plots. An analysis suggests that better practices due to the scientists' skills, and more chemical in-

puts accounted for a little less than one-half of the difference in yields. A little over half was attributable to better irrigation and better land. This suggests that many Philippine farmers using IRRI technology could increase average yields to 3.5 to 4 tons per hectare without any new capital expenditures if there were less restraint on their expenditures for fertilizer, disease and pest control, weed control, etc. Further increases in yield would require investments, chiefly for irrigation and water control to exploit the potentialities of the present HYV seeds. Three courses, then, are open to raise yields: (1) improve farming skills, input supplies, price relationships, credit, etc., (2) increase investments to improve water availability and control, and (3) develop varieties that are better adapted to the water-stress conditions found on farms.

The possibilities of improving yields, production, and income in each of these three ways constitutes a challenge. The optimum combination of the three ways will have to be studied and related to the various countries' needs.

The developing countries have some expertise in selecting areas of investigation which promise the highest returns for the least cost, and in working out solutions to specific problems. Development of HYV's suitable for irrigation lends immediate emphasis to expanding irrigation and improving facilities and management—at least until seed varieties are developed that are suitable for nonirrigated areas. But the limited adaptability of the varieties now available suggests that the need is even greater for the development of varieties that are less rigid in their demands. The approach will have to reflect the special conditions of the area. Assistance from developed countries will be needed, with the country to be helped providing a large part of the input and the needed continuity.

The research resources need to be directed into two types of organizations. The first is the international research institutes organized either along commodity lines or by type of climate. These institutions have made a distinguished record in a short time and are now being coordinated by the Consultative Group on International Agricultural Research, with the World Bank acting as coordinator.

The second is the national research organization, with experiment stations placed to study local adaptation. The building of productive national research institutions and the training of research workers has proven to be very difficult, but recent history emphasizes the essentiality of this link in the development process. In particular, research backing is needed for an effective extension program that reaches into the countryside.

b. ***Countries slow to exploit their potential***

Many of the Latin American countries have a large unexploited agricultural potential. With considerable land and generally good climate, they can feed themselves and export food and other agricultural products. They have substantial infrastructure arrangements and abundant natural resources. With determined efforts and the appropriate policies, they should be able to make use of foreign aid to expand production.

The countries in this group include most of the Andean group—Columbia, Peru, Bolivia, Ecuador, and Chile. Bolivia and Ecuador are now getting more money from oil. Chile has other resources and is more developed than the others in this group. Several of the Central American countries should also be able to expand agricultural production significantly. The latter countries have the special advantage of nearness to the American market for out-of-season fruits and vegetables. Food production progress for these countries also depends on access to export markets in the developed and developing countries.

2. Countries With Serious Production Constraints

A second group of developing countries poses the most serious food problems and includes both heavily and sparsely populated low-income countries that have few exports. For these countries, it is both desirable and necessary to stimulate food production, particularly cereals production.

This group of poor countries includes densely populated countries of Asia—such as Bangladesh, India, South Vietnam, and Sri Lanka. In the short run, these countries are vulnerable to high prices for grain, oil, and fertilizer imports. Reductions in fertilizer imports may cause shortfalls in food production at a time when expensive food imports are required and concessional food aid limited. The food situation faced by the many smaller—particularly African—countries in this group represents a more diverse set of problems. In Africa as a whole, food production has failed to grow as rapidly as population. The serious crisis in the Sahel is an extreme example of the food problem facing many poor countries.

But while the problems of the Sahelian countries are quite serious, there are good possibilities for increasing food production in them. In the more southerly regions of the Sahelian countries (the Sudanian Zone), rainfall is higher (20-40 inches) and more reliable. Because of the longer rainy season, longer cycle millet and medium-cycle sorghums can be grown. A major constraint to increasing food production in the Sahel and elsewhere in Africa, however, is the absence of adapted new and improved varieties of food grains and a package of inputs to go along with them.

3. Countries Which Have Traditionally Produced Food Surpluses

People in these countries are not in danger of starvation, nor in a critical food position at present. Yet these countries need to accelerate agricultural production and many need outside assistance. All have made some progress, but it is limited and a large part of the farming sector is almost completely left out of the modernizing advancing sector. They range from some of the very poor countries, through rapidly developing countries, to countries that are so well developed that they are often not considered to be developing countries.

- In Africa, they include Angola, Kenya, Malagasy Republic, and Rhodesia.

- In Asia, they include Thailand, Burma, Nepal, and Khmer Republic.

- In Latin America, the more developed countries of Mexico and Brazil are included, but differ from the others in that they are able to finance needed assistance. In each of these countries, much progress in development and modernization has been made, but very large regions—namely northeastern Brazil and Southern Mexico—have progressed little despite considerable attention and effort. Argentina and Uruguay also may be included in this group—both are relatively more developed—but their progress in more recent times has been limited.

4. Countries That Are Not Producing Enough Food to Keep Up With the Demand, But Are Able to Afford Imports

Some of these countries—particularly South Korea and Taiwan—have experienced sustained, rapid development. Other countries which can afford food imports are the natural-resource rich group—some of the OPEC countries, Morocco, and perhaps a few other countries that are sources of bauxite, tin, and copper.

Agricultural or food production in many of the OPEC countries, such as Algeria, Nigeria, Indonesia, Iran, and Saudi Arabia, is either declining or has failed to keep pace with population growth. Yet, these same countries are experiencing relatively rapid growth rates in per capita GDP and can count on growing reserves of foreign exchange. A comparable situation exists for countries experiencing favorable prices for exported raw materials other than oil, such as Morocco and Tunisia with phosphates and Bolivia with tin. Still other countries whose economies are based on growing service or manufacturing sectors would find food self-sufficiency a wasteful use of their resources.

Not only should reserves of foreign exchange tide many of these countries over the current problem of high food and energy prices, it should permit them to generate capital for long-run economic and agricultural development that has not always been available up to now. Indonesia and Nigeria both have very large groups of farmers who will require special assistance to participate in development. Venezuela, with a larger share of oil riches, has a somewhat smaller but still numerous farm population in need of assistance for modernization. Morocco, with phosphate sources, also has a group of farmers in need of assistance. Some countries in this group need foreign expertise, but not foreign financing.

11. THE WORLD FOOD CONFERENCE

The World Food Conference, held in Rome on November 5-16 and sponsored by the United Nations, was an expression of growing international concern about the critical nature of the world food situation.

In early September 1973 in Algiers, the Conference of Non-Aligned Countries had called for FAO and the U.N. Conference on Trade and Development to hold an emergency joint conference to formulate a program of international cooperation to overcome food shortages and maintain stable prices. Late in September 1973, U.S. Secretary of State Kissinger proposed to the U.N. General Assembly that the United Nations convene a world food conference in 1974. The Conference was attended by 130 voting-member countries of the United Nations, representatives of certain political movements, representatives of agencies affiliated with the United Nations, the International Atomic Energy Agency, the General Agreement on Tariffs and Trade, and several other nongovernmental organizations. The U.N. Economic and Social Council was given overall responsibility for arranging the Conference, while preparations were executed by a secretariat drawn from FAO.

Prior to the Conference, an "Assessment of the World Food Situation, Present and Future" was issued by the Conference secretariat. It took into account suggestions of the Conference Preparatory Committee and relevant deliberations of the April-May 1974 Special Session of the General Assembly on Raw Materials and Development. The Preparatory Committee also placed before the Conference the secretariat document "The World Food Problem: Proposals for National and International Action." These proposals, including the FAO-sponsored "International Undertaking on World Food Security," provided a specific focus for the conference deliberations, as did recommendations made at FAO's Seventeenth Conference, held in Rome in 1973.

The aims of the Conference are contained in a "Universal Declaration on the Eradication of Hunger," which proclaims that:

> "Every man, woman and child has the inalienable right to be free from hunger and malnutrition in order to develop fully and maintain their physical and mental facilities. Society today already possesses sufficient resources, organizational ability, and technology and hence the competence to achieve this objective. Accordingly, the eradication of hunger is a common objective of all the countries of the international community, especially of the developed countries and others in a position to help."

The resolution on "Objective and Strategies of Food Production" draws upon Secretary Kissinger's opening remarks at the Conference and states that:

> "All governments should accept the removal of the scourge of hunger and malnutrition . . . as the objective of the international community as a whole, and accept the goal that within a decade no child will go to bed hungry, that no family will fear for its next day's bread, and that no human being's future and capacities will be stunted by malnutrition."

The work of the Conference was organized to consider national and international programs of action according to the following agenda:

- —"Measures for increasing food production in developing countries within the wider framework of development;
- —"Measures for increasing food production in developed countries;
- —"Policies and programs for improving consumption patterns in all countries, and aiming at ensuring adequate availability of food in developing countries, particularly in vulnerable groups;
- —"The strengthening of world food security through measures including *inter alia* a better early warning and food information system, more effective national and international stock-holding policies and improved arrangements for emergency relief and food aid;
- —"Specific objectives and measures in the area of international trade and adjustment which are relevant to the food problems, including measures toward stabilization, and expansion of markets for exports from developing countries;
- —"Arrangements for follow-up action, including appropriate operational machinery on recommendations or resolutions of the Conference."

Nineteen substantive resolutions plus a concluding resolution calling for follow-up action were adopted at the Conference. The resolutions are summarized below. The achievement of the World Food Conference, however, cannot be fully assessed at this time, since that will depend on how governments, international organizations, and others respond to the Conference's recommendations.

Food Production

The Conference agreed that a substantial increase in food production is needed in the developing countries, and that short-term increases are needed in the developed countries in order to lessen the world's current vulnerability to crop shortfalls. Several of the recommendations propose programs and research efforts to achieve longer term gains in both the developing and developed countries.

An Agricultural Development Fund, for instance, proposed by the Organization of Petroleum Exporting Countries, would be used to finance agricultural development projects primarily for food production in the developing countries. Contributions to the fund would be voluntary. Their amount, lending criteria, and other policy and administrative details are to be worked out by interested parties at future meetings convened by the U.N. Secretary-General.

Among the proposals for research into greater food production were requests for a survey of world land resources to determine potential new land for food production; a study, to be made by the World Meteorological Organization, of weather-crop relationships, particularly in arid and semi-arid areas, and of changing weather and climatic patterns; studies of the efficiency of fertilizer and pesticide use; research into the development of plant varieties which make more efficient use of nutrients and water and which are more resistant to disease and pests; and an evaluation of past and present rural development programs.

Such research would support a variety of recommended programs for increased food supply. They include programs in resource development and conservation; water management; increased production and distribution of agricultural inputs such as fertilizers, pesticides, and improved seeds; extension and training aimed at transferring and adapting agricultural technology to the developing countries; and efforts to reduce all forms of food waste.

Nutrition

The Conference recognized that fundamental progress in the elimination of hunger and malnutrition will require economic growth in the developing countries to increase the productivity and incomes of those with the greatest need for food. For the short term, the Conference saw a need for expanded nutrition aid programs, particularly those for especially vulnerable groups. The Conference also called for more research into fortifying staple foods for improved nutrition at low costs.

Food Security

Early planning for the World Food Conference emphasized the long-term nature of the problem of increasing world food production, greater world food security, and the restoration of stability in world food supplies and prices. In the planning stage, the question of emergency food needs was considered mostly in terms of the desirability of creating an improved international emergency food system. By the time the Conference met in November, disappointing 1974 cereal crops had further reduced stocks and had made much of the world vulnerable to crop failures in 1975, even raising the threat of severe famine in countries such as India and Bangladesh.

Partly in response to current estimates of immediate emergency needs, the Conference recommended that 10 million tons of grain per year be made available as food aid beginning in 1975, and asked that contributions be in the form of both money and grain.

The Director-General of FAO called for a meeting of major grain exporting and importing countries and current and potential financial contributors to consider ways of increasing emergency food availability and financing facilities during fiscal 1975 and 1976. The major exporters and importers, except for the Soviet Union and the People's Republic of China, met in Rome on November 29 to make a preliminary assessment of the emergency food requirements of the neediest countries over the next several months and to consider sources of potential food or financial commitments to meet them. Additional consultations are likely before firm decisions are announced.

The Conference urged donor countries to channel more food aid through the World Food Program; to earmark stocks or funds, where possible, for international emergency requirements; and to develop international guidelines for coordinating distribution of emergency stocks to the most needy and vulnerable groups.

The Conference endorsed the International Undertaking on World Food Security, which had been approved in principle earlier by the FAO Council, and invited all governments to adopt the Undertaking and to bring it into operation as soon as possible.

The Undertaking provides for international cooperation in establishing a world network of national grain reserves through international consultations and exchange of information. In late November, the FAO Council gave final approval to the proposal, which awaits formal adherence by individual governments. The Conference invited the major grain producing, consuming, and trading countries to discuss ways to accelerate implementation of the principles contained in the Undertaking and to study the feasibility of establishing grain reserves to be located at strategic points.

The Conference resolved that a Global Information and Early Warning System on Food and Agriculture should be established and agreed that FAO is the most appropriate organization to operate such a system. FAO is requested to cooperate with other international organizations, particularly the International Wheat Council, in establishing the system. The People's Republic of China expressed reservations concerning the Early Warning System on the grounds that it violated national sovereignty.

The Conference requested all governments to participate voluntarily in the system and to regularly furnish as much current information as possible, including forecasts. Initially, the system is to concentrate on basic foods, particularly grains. Later it may cover a wider range of food commodities.

Agricultural Trade and Adjustment

The Conference called for the progressive reduction and eventual elimination of trade barriers, and urged improved access of agricultural exports to world

markets, particularly the exports of the developing countries. Governments were asked to consider the interests of developing countries in examining a variety of measures to promote greater food security, improved distribution of food aid, greater diversification of exports, growth of foreign exchange earnings, and incentive prices to farmers.

The Conference endorsed the view that the increasing interdependence of national economies necessitated a global concept of agricultural adjustment, but the developed and developing countries were generally divided over the appropriateness of the World Food Conference as the forum for more detailed discussions. It was agreed that such discussions would take place within the framework of the multilateral trade negotiations of the General Agreement on Tariffs and Trade as agreed upon in the Tokyo Declaration. However, the Conference recommended that farm-support policies of developed countries should consider the interests of the food-exporting developing countries. The Conference also asked developed countries to expand their Generalized System of Preferences and to consider its extension to agricultural commodities, including both processed and semiprocessed products.

Other Concerns

The Conference did not deal directly with the problem of rapid population growth, since a World Population Conference had been held in August 1974. It did, however, adopt a resolution on the "Achievement of a Desirable Balance between Population and Food Supply," which reiterated the need for rational population policies.

The Council also approved a resolution, "Food and Women," which called upon governments to involve women fully in making decisions on food production and nutrition policies; to promote equal rights and responsibilities for men and women; and to include in their development plans provision for education and training of women in food production and agricultural technology, marketing and distribution.

One resolution called upon governments to reduce military expenditures on behalf of development, with some of these funds allocated to increasing food production in developing countries and to establishing emergency food reserves. Another called for intensified food aid to certain areas in Africa to compensate for damage arising out of political struggles there.

Follow-Up Action and Operational Machinery

Some of the follow-up actions of the World Food Conference have been discussed above. They include steps to form an international Agricultural Development Fund; a call for the leading grain exporting and importing countries and potential financers of food aid to discuss immediate requirements, and approval and implementation of the International Undertaking on World Food Security. Implementation of the Conference's other recommendations will depend in great part upon the support given by governments to the activities carried out by proposed new, or strengthened administrative machinery.

World Food Council

The Conference proposed that the General Assembly establish a World Food Council to coordinate implementation of the Conference's recommendations concerning food production, nutrition, food security and food trade, food aid, and related matters (see organization chart). The Council would also periodically review the major problems and policy issues affecting the world food situation in order to adopt an integrated approach toward the solution of world food problems. The Council would establish its own program for coordinating the activities of relevant U.N. agencies, giving special attention to the problems of the least developed countries and the most vulnerable groups, while exercising broad consultative and advisory authority on a wide range of food matters.

The Council's membership—perhaps 25—would reflect a balanced geographical representation and would consist of U.N. members, or members of the specialized agencies, who would be nominated by the U.N. Economic and Social Council and elected by the General Assembly. It was recommended that FAO provide administrative support to the new council. The Council will report to the U.N. General Assembly through the Economic and Social Council.

Food and Agriculture Organization

The World Food Conference gives an expanded role to FAO by increasing its activities and by adding new administrative functions. The following additions and changes in the FAO organization were recommended:

Committee on World Food Security—This Committee, proposed as a standing committee of the FAO Council, would submit periodic reports to the World Food Council. The Committee would keep current on the situation and outlook for basic foodstuffs in the context of world food security; make periodic evaluations of the adequacy and distribution of world food stocks, including those for food aid; review the steps taken by governments to implement the proposed International Undertaking on World Food Security; and recommend policy actions necessary to assure cereal supplies for minimum world food security.

Committee on Food Aid Policies and Programs—This Committee, to be formed from a reorganized Intergovernmental Committee of the World Food Program, would coordinate food aid policies recommended by the World Food Conference. It would make periodic and special reports to the World Food Council. The Committee would provide a forum for intergovernmental consultations on national and international food aid programs and policies with the aim of improving the coordination between bilateral and multilateral food aid. It also would review trends in food aid requirements and availabilities and recommend improvement in food aid policies and programs to governments through the Council.

Commission on Fertilizers—This FAO Commission is charged with taking the initiative in working with the United Nations Industrial Development Organization, the World Bank, and other agencies to implement the Conference's resolutions dealing with fertilizers, pesticides, fungicides, and herbicides.

Global Information System—FAO is to examine its ability to expand its situation and outlook activities to carry out the Conference Resolution on the Global Information and Early Warning System on Food and Agriculture. It will recommend to the 1975 FAO Council any new arrangements which may be necessary to provide global coverage, drawing upon the help of the U.N. Economic and Social Council, the International Wheat Council, and other organizations, and provide periodic progress reports to the World Food Council.

Consultative Groups

Consultative Group on International Agricultural Research—This group and its Technical Advisory Committee are requested to assume leadership in following up on matters contained in the Conference's resolution on research. The FAO, the World Bank, the United Nations Development Program, and other international organizations are to investigate the desirability of using this organizational approach in other sectors such as extension, agricultural credit, and rural development. The various Consultative Groups would be staffed jointly by the above organizations.

Consultative Group on Food Production and Investment—This group would be charged with increasing, coordinating, and improving the efficiency of financial and technical assistance—both bilateral and multilateral—to agricultural production in developing countries. The Development Committee established by the World Bank and International Monetary Fund is to review the adequacy of the external resources available for procurement of food and food production inputs in order to consider new measures for increasing resource transfers, particularly to the less advantaged countries.

ANNEX: SUMMARY OF WORLD FOOD CONFERENCE RESOLUTIONS

1. Objectives and Strategies of Food Production. This resolution resolves that all governments should accept the removal of the scourge of hunger and malnutrition. It calls upon the developing countries to give high priority to formulating plans, both short and longer term, for food production through agricultural and fisheries development; to promote changes in rural socioeconomic structures; and to develop adequate supporting services. Governments are called upon to increase their development assistance, facilitate greater access to inputs by developing countries, support the U.N. Special Program and the Agricultural Development Fund, and reduce the waste of food and agricultural resources.

FAO, the U.N. Development Program, and other international institutions are urged to identify potentially productive land and local financial resources for its development and to indicate ways for promoting additional food production. All appropriate international agencies are requested to substantially increase their agriculture and fisheries assistance, giving priority to benefiting the poorest groups; streamline assistance procedures; and mobilize international support in overcoming hunger and malnutrition.

2. Priorities for Agricultural and Rural Development. This resolution calls for appropriate agrarian reforms and institutional improvements aimed at generating employment, income, and integrated development in rural areas; eliminating any exploitative patterns of land tenure, lending, and marketing; improving credit, marketing, and input distribution systems; and promoting cooperative organizations for farmers and rural workers. Governments are requested to intensify rural educational efforts to aid women and end illiteracy within a decade. Programs are to be designed individually for nations and regions. The U.N. Development Program, the World Bank, FAO, and other agencies are called on to improve their technical and administrative capacity, and to greatly expand resources devoted to integrated rural development. FAO is called upon to collect, evaluate, and disseminate the results of past and ongoing rural development programs and to determine the suitability of such programs for expanding agricultural production and social integration.

3. Fertilizers. This resolution asks developed countries and various international agencies to help meet developing countries' fertilizer needs by providing material and financial support for the International Fertilizer Supply Scheme; extending grants and concessional loans for fertilizer and raw material imports; organizing a joint program to improve fertilizer plant efficiency; assisting in building new fertilizer production capacity in appropriate developing countries; and by assisting all developing countries to establish storage facilities, distribution services, and related infrastructures.

Cooperative fertilizer ventures are to be examined among fertilizer producing and consuming countries to promote more economic and stable fertilizer production and supply systems. The resolution requests the FAO Commission on Fertilizers and others to analyze the long-term fertilizer supply and demand position as part of a world fertilizer policy which avoids cyclical supply/demand imbalance and ensures stable fertilizer supplies at reasonable prices.

All countries are requested to introduce fertilizer quality standards; promote the most efficient use of fertilizers, including utilization of nonmineral sources of plant nutrients; and to voluntarily reduce noncritical uses. The transfer of technical knowledge on fertilizer production and use among all countries is to be intensified as are improved extension services and farmer training. The resolution also calls for research into augmenting soil fertility and plant growth through improved mineral fertilizers and use of locally available plant nutrients, organic fertilizers, biological fixation of

nitrogen, micro-elements, and crop varieties which are more efficient in nutrient utilization.

4. Food and Agricultural Research, Extension, and Training recommends increased support for programs related to the survey, conservation, and effective utilization of all agricultural resources, particularly soil, water, and plant and animal genetic resources. A global network of plant genetic resource centers is urged, to be followed by work on animal genetic resources.

Research programs are to be stepped up at research centers in developed and developing countries and at international and regional research institutes in order to increase yields and to reduce production costs in such projects as biological nitrogen fixation, solar and geophysical energy, plant introduction, genetic breeding, and new human and animal food sources. The resolution calls for greater research into weather, climate, alternate land use and management systems, and food resources from both the sea and inland aquaculture. To improve coordination of research efforts and to ensure the rapid dissemination of the information to agricultural producers, FAO is asked to undertake systematic collection of current research, especially that relative to developing countries. A substantial enlargement of the Consultative Group on International Agricultural Research is recommended. Other recommendations include a study on remote-sensing techniques in agriculture, using data from Earth Resources Satellites. Demonstration programs for testing and teaching are recommended, with priority on agricultural training at all levels, and with special emphasis on extension work. The resolution also recommends a substantial increase in funds from national, regional, and international sources for agricultural research, extension, and training in and for developing countries. The proposal is made that all countries cooperate to reduce the loss of specialized technical personnel from developing countries.

5. Policies and Programs to Improve Nutrition recommends that each country formulate integrated food and nutrition plans and policies based on careful assessments of malnutrition in all socioeconomic groups and preconditions for improving their nutritional status. The objective is "to eliminate within a decade hunger and malnutrition." FAO, in cooperation with the World Health Organization, the U.N. Children's Fund, the World Food Program, the World Bank, the U.N. Development Program, and the U.N. Educational, Scientific, and Cultural Organization and assisted by the Protein Advisory Group is to prepare a project proposal by mid-1975 for assisting governments in developing broad food and nutrition plans.

Governments are recommended to use national, international, and bilateral sources to initiate or strengthen food and nutrition programs. Governments are asked to provide nutritional education at all levels; strengthen basic health, family well-being, and planning services; improve environmental conditions, including water supplies; provide treatment for people with protein energy malnutrition; improve the status of women and encourage breast feeding; establish or improve nutrition and special feeding programs, especially for vulnerable groups (children and pregnant or nursing women); use increased local food production where feasible; examine possibilities of fortifying staples with amino-acids, protein concentrates, vitamins, and minerals to eliminate nutrient deficiencies; establish consumer education and protection programs; modernize food legislation and food contract programs; increase support of the Codex Alimentarius Commission; consider funds and facilities for broad programs of applied nutrition research; and cooperate with other governments and nongovernmental organizations in nutrition-related activities.

International agencies and nongovernmental agencies are asked to contribute funds and food for emergency supplementary feeding programs for children beginning in 1975-76. The World Health Organization is asked to establish a worldwide control program to reduce deficiency of Vitamins A and D, iodine, iron/folate, riboflavin, and thiamine. FAO is asked to take an inventory of noncereal vegetable food resources and to study possibilities of increasing their production and consumption. The resolution recommends that a joint FAO-World Health Organization food contamination monitoring program be developed to provide early warning to national authorities, FAO, the World Health Organization, and the U.N. Children's Fund; that a global nutrition surveillance system be established to monitor food and nutrition conditions; and that an internationally coordinated program in applied nutritional research be arranged.

6. World Soil Charter and Land Capability Assessment recommends that governments apply soil protection and conservation measures to all attempts to increase agricultural production. It also recommends that FAO, U.N. Educational, Social and Cultural Organization, U.N. Development Program, the World Meteorological Organization, and other international organizations prepare an assessment of remaining cultivatible land, taking account of forestry for protection of catchment areas required for alternative uses. FAO is urged to establish a World Soil Charter as a basis of international cooperation for most rational use of the world's land resources.

7. Scientific Water Management: Irrigation, Drainage, and Flood Control calls for corrected action by governments, FAO, World Meteorological Organization, and other international agencies to undertake extensive surveys of climate, water, irrigation potential, hydropower potential, energy requirements for irrigation, and expand irrigation capacities as rapidly as possible; develop safe uses of brackish water in food production; reclaim areas affected by waterlogging, salinity, and alkalinity; identify and exploit ground water resources and develop better uses of scarce water and ways of improving crop production in arid areas; complement flood protection and flood control measures, including watershed management, soil conservation, lift irrigation, and groundwater exploitation; establish suitable drainage systems to control salinity in swampy areas; develop controls for desert crops; and develop better water technology and water delivery systems. Extensive aid to developing countries and extensive research into the use of solar hydro-electric power, geo-thermal and wind energy in agricultural production are urged.

8. Food and Women calls on governments to involve women fully in the decision making for food production and nutrition policies; promote equal rights and responsibilities for men and women and include in national development plans provision for education and training of women in food production and agricultural technology, marketing, and distribution techniques, as well as credit and nutrition consumer information; and provide women with full effective access to all medical and social services, food for pregnant and lactating women, means to space their children, and child health and development education.

9. Achievement of a Desirable Balance between Population and Food Supply points to the increasing difficulty in meeting the food needs of a rapidly growing world population and to consensus on a World Population Plan of Action reached at the August 1974 World Population Conference. The resolution calls on governments and people everywhere to support rational population policies which ensure couples the right to determine the number and spacing of births, freely and responsibly, in accordance with national needs within the context of an overall development strategy.

10. Pesticides[1] —This resolution recommends international coordination of efforts to assure an adequate supply of pesticides, including where possible the local manufacture and establishment of reserve stocks; programs to increase the efficiency of protection measures, taking into account the elements of supply, information, training, research, and quality control; and the promotion of a strong continuing program of research into the mechanism of resistance in both plants and pests—especially as applicable to the development of integrated pest management in tropical and subtropical areas—and on the residual effects of pesticides. It calls on appropriate international agencies to convene on an urgent basis an *ad hoc* consultation with member governments and industry to promote implementation of the resolution.

11. Program for the control of African animal trypanosomiasis asserts that an integrated economic development plan for Africa should begin with trypanosomiasis and tsetse control. It calls for a small coordinating unit at FAO to immediately initiate as the first phase of the program training, pilot field control projects, and applied research, in preparation for future large-scale operations for the control of African animal trypanosomiasis.

12. Seed Industry Development urges developing countries to make continuing commitments of manpower, institutional, and financial resources for seed industry development; recommends policies and legislation for the production, processing, quality control, distribution, marketing, and promotion of quality seed and education of farmers in their use; and proposes that the FAO Seed Industry Development Program be strengthened to meet demands for seed production, seed export, and training of competent technical and managerial manpower.

13. International Fund for Agricultural Development resolves that an International Fund for Agricultural Development should be established immediately to finance agricultural development projects, primarily for food production in the developing countries. A Governing Board reflecting equitable distribution of contributing countries and potential recipient countries would administer the Fund. The U.N. Secretary-General is requested to convene urgently a meeting to work out the details, including the size and commitments to the Fund. Voluntary contributions are requested. Disbursements are to be effected through the Governing Board on a regionally equitable basis. When the Secretary-General determines, in consultation with contributors, that substantial additional resources can be generated and prospects for continuity of operation are reasonable, the Fund would become operative.

14. Reduction of Military Expenditures for Increasing Food Production calls on countries to rapidly implement all U.N. Resolutions pertaining to the reduction of military expenditures on behalf of development, and to allocate a growing proportion of these sums to finance food production in developing countries and establish reserves for emergency cases.

15. Food Aid to Victims of Colonial Wars in Africa requests FAO and the World Food Program "to take immediate action to intensify food aid to Ghinea Bissau, Cape Verde, Mozambique, Angola, Sao Tome, and Principe;" and requests the U.N. Secretary-General and other U.N. organizations "to assist the national liberation movements or the governments of these countries to formulate a comprehensive plan of national reconstruction."

16. Global Information and Early-Warning System on Food and Agriculture cites the urgent need for a worldwide food information system to identify areas with imminent food problems, monitor world food supply-demand conditions, and contribute to the effective functioning of the proposed International Undertaking on World Food Security. It resolves that a Global Information and Early Warning System on Food and Agriculture should be established under FAO. In cooperation with other international organizations —particularly the International Wheat Council—FAO would formulate the necessary arrangements for final approval by participating countries.

All governments are requested to participate in the System by voluntarily and regularly furnishing as much information and forecasts as possible on basic food products, particularly wheat, rice, coarse grains, soybeans, and livestock products. Governments are also asked to provide information on food supply-demand situations affecting world food security, such as production levels and prices for agricultural inputs; and to amplify and improve their data collection and dissemination services concerning food production, nutritional levels, input supplies, meteorology, and crop/weather relationships both nationally and regionally. International organizations are to help where appropriate.

[1] Includes insecticides, herbicides, fungicides, acaricides, rodenticides, growth regulators, and other pest control measures.

The World Meteorological Organization is asked to cooperate with FAO in providing regular assessments of current weather based on information now assembled through the World Weather Watch to identify changes in weather patterns. It is also asked to cooperate with FAO in expanding joint research to investigate weather/crop relationships, particularly in arid and semi-arid areas; strengthening the global weather monitoring system at the national and regional levels to make them directly relevant to agriculture; and encouraging investigations to which assess the probability of adverse weather conditions in various agricultural regions, and which bring a better understanding of the causes of climatic variations.

The information collected in the System is to be analyzed and disseminated periodically to all participating governments for their exclusive use; certain information, when requested, could be disseminated in aggregate form to avoid unfavorable market repercussions.

17. International Undertaking on World Food Security endorses the objectives, policies, and guidelines of the proposed International Undertaking on World Food Security and urges its adoption and implementation as soon as possible. The Draft International Undertaking on World Food Security affirms common responsibility of the international community for adequate policies on world food, asks all states to participate, and calls for national stocks, particularly of grain, to be maintained. The amounts for individual nations are to be nationally determined and information is to be shared with the objective of ensuring a globally sufficient amount. The resolution also recommends a study of the feasibility of establishing grain reserves at strategic points. It urges governments and other organizations to provide the necessary technical, financial, and food assistance for implementing appropriate national food stock policies in developing countries.

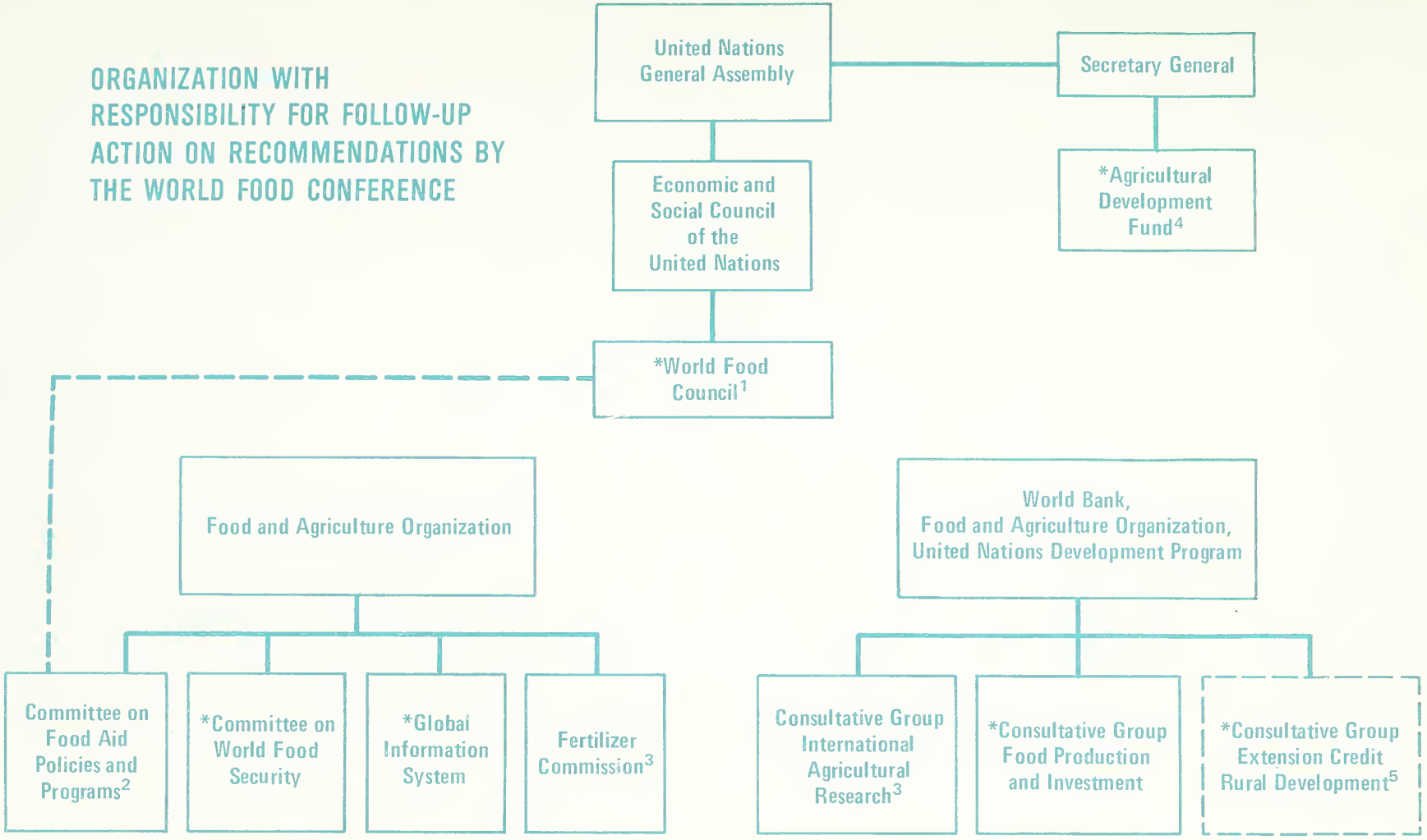
18. An Improved Policy for Food Aid affirms the need for forward planning of a continuous, augmented amount of food aid. Donor countries are asked to provide commodities or financial assistance for a minimum of 10 million tons of grain for food aid a year, in addition to other food commodities, starting in 1975. Donor countries are also urged to channel more food aid through the World Food Program, increase the grant component of bilateral food aid, consider applying part of food aid repayments to supplementary nutrition programs and emergency relief, and where possible to purchase such food for aid from developing countries. The resolution recommends that stocks or funds be earmarked for international emergency requirements and that international guidelines for such emergency stocks be developed to ensure that food relief reaches the neediest and most vulnerable groups. Part of such emergency stocks would be placed voluntarily at the disposal of the World Food Program to increase its capacity for reacting to emergencies.

19. International Trade and Adjustment requests that all states cooperate in expanding and liberalizing world trade and improving the trading position of exports from developing countries. The resolution requests that donors purchase food aid from developing countries whenever possible, that developed countries and international organizations increase field assistance to developing countries in export promotion activities and the training of marketing people, that financial institutions give favorable treatment to developing countries with balance-of-payments difficulties, that FAO consider World Food Conference discussions in their international adjustment strategy, and that the U.N. Conference on Trade and Development intensify efforts to develop new approaches to international commodity problems and policies.

The U.N. Conference on Trade and Development is urged to consider new approaches to international commodity problems and to establish a time-table for appropriate action. Appropriate international bodies are asked to speed up negotiations on agreements to reduce trade barriers and restrictions and to improve developing countries' access to developed countries markets for food and agricultural products along lines laid down in the Tokyo General Agreement on Tariffs and Trade framework, including the concept of nonreciprocity and differential measures favoring the developing countries where feasible through negotiations.

All developed countries are requested to implement, improve, and enlarge their schemes under the Generalized System of Preference and to consider extending it to food and agricultural commodities.

ORGANIZATION WITH RESPONSIBILITY FOR FOLLOW-UP ACTION ON RECOMMENDATIONS BY THE WORLD FOOD CONFERENCE



*New Institutions

[1]About 25 members, nominated by ECOSOC, geographically representation, elected by UNGA, uses FAO Secretariat in Rome, with powers to coordinate, advise and receive reports.

[2]To be formed from the reconstituted Committee on World Food Program which now reports to ECOSOC.

[3]Program Strengthened.

[4]Called by United Nations Secretary General, governed by own Board.

[5]An organization with this title, or similar to it, is likely to be recommended in the future.

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